



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.08.2013 Bulletin 2013/35

(51) Int Cl.:
F02D 9/10 (2006.01)
F02M 35/10 (2006.01) **F02M 35/116 (2006.01)**

(21) Application number: **13152126.2**

(22) Date of filing: **22.01.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
 Designated Extension States:
BA ME

(72) Inventors:
 • **Toriumi, Masahiro**
Tochigi, Tochigi (JP)
 • **Tanida, Makoto**
Tochigi, Tochigi (JP)

(30) Priority: **21.02.2012 JP 2012035409**

(74) Representative: **Trossin, Hans-Jürgen**
Weickmann & Weickmann
Postfach 860 820
81635 München (DE)

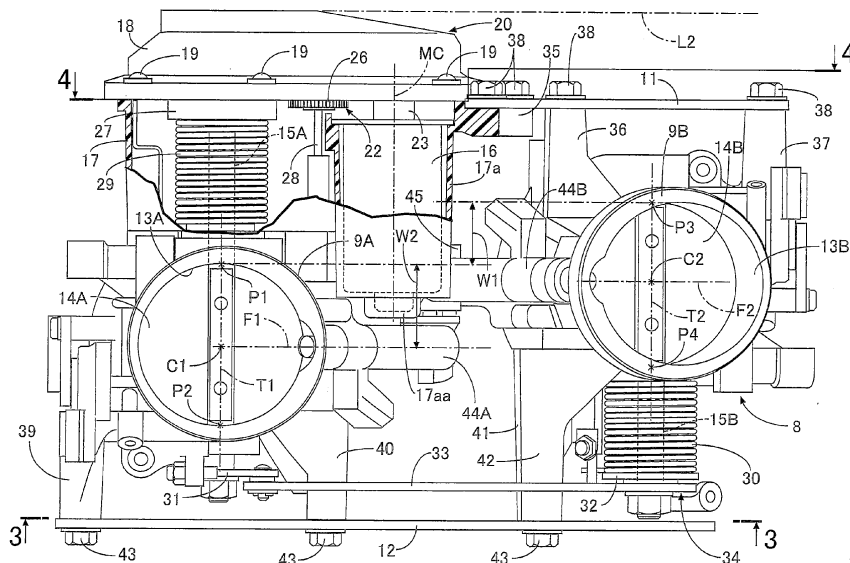
(71) Applicant: **Keihin Corporation**
Tokyo 163-0539 (JP)

(54) **Air intake system of v-type engine for vehicle**

(57) In an air intake system of a V-type engine for a vehicle, a pair of throttle bodies connected to each other and placed between a pair of banks includes throttle valves, respectively, and an electric motor is interlinked with and connected to the throttle valves. At least part of an electric motor (16) placed between first and second throttle bodies (9A, 9B) is placed within a range (W1) of offset in a vehicle widthwise direction between points of intersection (P1, P3) on the one side in the vehicle widthwise direction, which are points of intersection between turn axis lines (T1, T2) of first and second throttle valves

(14A, 14B) and inner surfaces of first and second air intake passages (13A, 13B), respectively, and is also placed among one ends and opposite ends of the respective first and second throttle bodies (9A, 9B) in a direction orthogonal to a virtual plane passing through the turn axis lines (T1, T2). A first coil spring (29) is placed at one side of the first throttle body (9A) in the vehicle widthwise direction, and a second coil spring (30) is placed at a side of the second throttle body (9B), which is a side opposite from the side on which the electric motor (16) is placed. Accordingly, the air intake system can be made compact.

FIG.2



Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to an air intake system of a V-type engine for a vehicle, and especially relates to an air intake system of a V-type engine for a vehicle in which: a first throttle body and a second throttle body are placed between first and second banks in a V configuration which are provided to an engine main body mounted on a vehicle, the first throttle body including a first air intake passage and a first throttle valve for opening and closing the first air intake passage, the first throttle body corresponding to the first bank, the second throttle body including a second air intake passage and a second throttle valve for opening and closing the second air intake passage, the second throttle body corresponding to the second bank, the first throttle body and the second throttle body being connected to each other, and turn axis lines of the respective first and second throttle valves extending in a vehicle widthwise direction; and an electric motor which is common between the first and second throttle valves has a rotation axis line in parallel with the turn axis lines of the respective first and second throttle valves, and is interlinked with and connected to the first and second throttle valves.

DESCRIPTION OF THE RELATED ART

[0002] Each of Japanese Patent Application Laid-open No. 2009-85111 and Japanese Patent Application Laid-open No. 2004-132290 has already made known an air intake system of a V-type engine for a vehicle in which throttle bodies corresponding to a pair of banks and provided with their respective fuel injection valves are placed between the two banks.

SUMMARY OF THE INVENTION

[0003] In the air intake system disclosed by Japanese Patent Application Laid-open No. 2009-85111, in a side view, an electric motor for commonly driving throttle valves of throttle bodies corresponding to one of the banks and throttle valves of throttle bodies corresponding to the other one of the banks is placed outside the throttle bodies corresponding to the one of the banks. As a result, the air intake system is large in a direction in which the two banks are arranged. On the other hand, in the air intake system disclosed by Japanese Patent Application Laid-open No. 2004-132290, in a side view, an electric motor for commonly driving throttle valves of a throttle body corresponding to one of the banks and throttle valves of the other throttle body corresponding to the other one of the banks is placed between the two throttle bodies. Although this solves the problem posed by Japanese Patent Application Laid-open No. 2009-85111, the

air intake system is large in size in a direction along the pivoting axes of the respective throttle valves because coil springs for biasing the throttle valves in a closing direction are placed in locations where some of the throttle valves are interposed between the coil springs and a driving force transmission place where driving force is transmitted from the electric motor to the throttle valves.

[0004] The present invention has been made with the foregoing situation taken into consideration. An object of the present invention is to provide an air intake system of a V-type engine for a vehicle which can be made compact.

[0005] In order to achieve the object, according to an invention described in claim 1, there is provided an air intake system of a V-type engine for a vehicle in which: a first throttle body and a second throttle body are placed between first and second banks in a V configuration which are provided to an engine main body mounted on a vehicle, the first throttle body including a first air intake passage and a first throttle valve for opening and closing the first air intake passage, the first throttle body corresponding to the first bank, the second throttle body including a second air intake passage and a second throttle valve for opening and closing the second air intake passage, the second throttle body corresponding to the second bank, the first throttle body and the second throttle body being connected to each other, and turn axis lines of the respective first and second throttle valves extending in a vehicle widthwise direction; and an electric motor which is common between the first and second throttle valves has a rotation axis line in parallel with the turn axis lines of the respective first and second throttle valves, and is interlinked with and connected to the first and second throttle valves, **characterized in that** in a projection view obtained by projection to a horizontal plane, the first and second throttle bodies are placed with a center axis line of the second air intake passage offset from a center axis line of the first air intake passage toward one side in the vehicle widthwise direction, in the projection view, at least part of the electric motor placed between the first and second throttle bodies is placed within a range of offset in the vehicle widthwise direction between a point of intersection on the one side in the vehicle widthwise direction and a point of intersection on the one side in the vehicle widthwise direction, the point of intersection being one of points of intersection between the turn axis line of the first throttle valve and an inner surface of the first air intake passage, and the point of intersection being one of points of intersection between the turn axis line of the second throttle valve and an inner surface of the second air intake passage, at least the part of the electric motor is placed among one ends and opposite ends of the respective first and second throttle bodies in a direction orthogonal to a virtual plane passing through the turn axis lines of the respective first and second throttle valves, a first coil spring for biasing the first throttle valve in a closing direction is placed at one side of the first throttle body in the vehicle widthwise direction, and a

second coil spring for biasing the second throttle valve in a closing direction is placed at a side of the second throttle body, which is a side opposite from the side on which the electric motor is placed, in the vehicle widthwise direction.

[0006] According to the invention described in claim 1, the electric motor is placed between the first throttle body including the first air intake passage and the second throttle body including the second air intake passage. For this reason, the air intake system can be made compact in the direction in which the first and second throttle bodies are arranged, compared with an air intake system in which an electric motor is placed outside two throttle bodies. In addition, the electric motor, which is a heavy object, is placed in the center portion of the air intake system in the arrangement direction. For this reason, the vibration of the electric motor can be reduced to a lower level. Furthermore, in the projection view obtained by projection to the horizontal plane, the center axis line of the second air intake passage is offset from the center axis line of the first air intake passage toward the one side in the vehicle widthwise direction; in the projection view, at least the part of the electric motor is placed within the range of offset in the vehicle widthwise direction between the points of intersection on the one side in the vehicle widthwise direction at which the turn axis lines of the first and second throttle valves intersect with the inner surfaces of the first and second air intake passages, respectively; the first coil spring for biasing the first throttle valve in the closing direction is placed at a side of the first throttle body in the vehicle widthwise direction, which is the side on which the electric motor is placed; and the second coil spring for biasing the second throttle valve in the closing direction is placed at a side of the second throttle body, which is the side opposite from the side on which the electric motor is placed, in the vehicle widthwise direction. For these reasons, the air intake system can be made compact in the vehicle widthwise direction, and the layout for placing the air intake system between the first and second banks of the V-type engine can be made easier. Moreover, the first coil spring is placed at a side of the first throttle body in the vehicle widthwise direction, which is the side on which the electric motor is placed. For this reason, it is possible to reduce distortional deformation which occurs on the valve shaft, which is provided with the first throttle valve, due to force acting on the valve shaft from the first coil spring for biasing the first throttle valve in the closing direction and from the electric motor. What is more, at least the part of the electric motor is placed among the one ends and the opposite ends of the respective first and second throttle bodies in the direction orthogonal to the virtual plane passing through the turn axis lines of the respective first and second throttle valves. For this reason, the air intake system can be made compact in an air intake flow direction of each of the first and second air intake passages. Thereby, also with this configuration, the layout for placing the air intake system between the first and second banks can

be made easier.

[0007] Further, according to an invention described in claim 2, in addition to the configuration of claim 1, there is provided the air intake system of a V-type engine for a vehicle, wherein a first fuel injection valve for injecting fuel downstream of the first throttle valve is attached to the first throttle body from the second throttle body side in a way that: in a side view, at least part of the first fuel injection valve overlaps the electric motor or a motor housing portion provided continuously to the first throttle body on the one side in the vehicle widthwise direction and housing the electric motor; and the first fuel injection valve is placed among the one ends and the opposite ends of the respective first and second throttle valves in a direction orthogonal to the virtual plane, a second fuel injection valve for injecting fuel downstream of the second throttle valve is attached to the second throttle body from the first throttle body side in a way that the second fuel injection valve is placed among the one ends and the opposite ends of the respective first and second throttle valves in the direction orthogonal to the virtual plane, and in the projection view obtained by projection to the horizontal plane, an opposite end portion of the electric motor in the vehicle widthwise direction or an opposite end wall of the motor housing portion in the vehicle widthwise direction is placed between the first fuel injection valve and the point of intersection on the one side in the vehicle widthwise direction, which is one of the points of intersection between the turn axis line of the first throttle valve and the inner surface of the first air intake passage.

[0008] According to the invention described in claim 2, the first fuel injection valve for injecting the fuel downstream of the first throttle valve and the second fuel injection valve for injecting the fuel downstream of the second throttle valve are placed among the one ends and the opposite ends of the respective first and second throttle bodies in the direction orthogonal to the virtual plane passing through the turn axis lines of the respective first and second throttle valves. Thereby, the air intake system can be made compact in the air intake flow direction of each of the first and second air intake passages. In addition, in the side view, the first fuel injection valve is placed with the part of the first fuel injection valve overlapping the electric motor or the motor housing portion. For this reason, the second fuel injection valve is placed closer to the electric motor or the motor housing portion in the direction in which the first and second throttle bodies are arranged. Thereby, the air intake system can be made compact in the direction in which the first and second throttle bodies are arranged. Furthermore, in the projection view obtained by projection to the horizontal plane, the opposite end portion of the electric motor in the vehicle widthwise direction or the opposite end wall of the motor housing portion in the vehicle widthwise direction is placed between the first fuel injection valve and the point of intersection on the one side in the vehicle widthwise direction, which is one of the points of intersection between the turn axis line of the first throttle valve

and the inner surface of the first air intake passage; and the electric motor or the motor housing portion is placed closer to the first fuel injection valve. By these, the air intake system can be made compact in the vehicle widthwise direction. Moreover, from the second throttle body side, the first fuel injection valve is attached to the first throttle body; and from the first throttle body side, the second fuel injection valve is attached to the second throttle body. For this reason, the air intake system can be made compact in the direction in which the two throttle bodies are arranged, compared with an air intake system in which at least one of the first and second fuel injection valves is attached to at least a corresponding one of the two throttle bodies from a side opposite from the other one.

[0009] Further, according to an invention described in claim 3, in addition to the configuration of claim 2, there is provided the air intake system of a V-type engine for a vehicle, wherein a tubular case main body a part of which forms the motor housing portion is connected to the first throttle body in a way that is open to the one side in the vehicle widthwise direction, the first coil spring is housed in a housing case formed from the case main body and a cover member which is fastened to the case main body in a way that closes an outer end opening portion of the case main body, a case-side fastening portion sticking out beyond the cover member towards the second throttle body is integrally provided to an outer end portion of the part, which forms the motor housing portion, of the case main body, and a connection plate is fastened to: an arm-shaped fastening portion integrally provided to the second throttle body and projecting to the one side in the vehicle widthwise direction; and the case-side fastening portion.

[0010] According to the invention described in claim 3, the tubular case main body is connected to the first throttle body in a way that the part of the tubular case main body forms the motor housing portion; the cover member which, together with the case main body, forms the housing case in which to house the first coil spring is fastened to the case main body in the way that closes the outer end opening portion of the case main body; the case-side fastening portion sticking out beyond the cover member towards the second throttle body is integrally provided to the outer end portion of the part, which forms the motor housing portion, of the case main body; and the connection plate is fastened to the arm-shaped fastening portions integrally provided to the second throttle body and projecting to the one side in the vehicle widthwise direction, and to the case-side fastening portion. For these reasons, by use of the simple structure which needs no specialized arm-shaped fastening portion for fastening the connection plate to be projectingly provided to the first throttle body, in the projection view obtained by projection to the horizontal plane, the end portion of the second throttle body on the one side in the vehicle widthwise direction can be accommodated within a range in the vehicle widthwise direction which reaches an outer

end of the cover member. Moreover, since the distance from the second throttle body to the case-side fastening portion is short, and since the motor housing portion in which to house the electric motor is placed in the vicinity of the case-side fastening portion, the second throttle body is capable of effectively reducing the amplitude of vibration of the electric motor and the motor housing portion which occurs due to the vibration of the vehicle body; and the connection plate can be made smaller.

[0011] Here, a first connection plate 11 of an embodiment corresponds to the connection plate of the present invention.

[0012] The above and other objects, characteristics and advantages of the present invention will be clear from detailed descriptions of the preferred embodiment which will be provided below while referring to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a side view of an intake system and an essential part of an engine main body; FIG. 2 is a view seen from a direction of an arrow 2 in FIG. 1 in a state where a part of the intake system is cut out; FIG. 3 is a sectional view taken along a line 3-3 in FIG. 2; and FIG. 4 is a sectional view taken along a line 4-4 in FIG. 2.

DESCRIPTION OF PREFERRED EMBODIMENT

[0014] Descriptions will be hereinbelow provided for an embodiment of the present invention while referring to the attached FIGS. 1 to 4.

[0015] First of all, in FIG. 1, an engine main body 6 built in a V-type twin-cylinder configuration is mounted on a two-wheeled motor vehicle which is a type of vehicle. This engine main body 6 includes a first bank BA and a second bank BB which form a V shape by separating from each other in a front-rear direction of the two-wheeled motor vehicle, and is accordingly built in the V type.

[0016] An air intake system 8 is arranged in a space between the first and second banks BA, BB of the engine main body 6. The air intake system 8 includes: a first throttle body 9A on the first bank BA side, whose downstream end is connected to a cylinder head 7A of the first bank BA; a second throttle body 9B on the second bank BB side, whose downstream end is connected to a cylinder head 7B of the second bank BB; and an air cleaner 10 to which upstream ends of the respective first and second throttle bodies 9A, 9B are commonly connected.

[0017] The first and second throttle bodies 9A, 9B are connected to each other. The first and second throttle bodies 9A, 9B are connected to each other by means of a first connection plate 11 on one side (in this embodiment, on an upper side in FIG. 2) in a vehicle widthwise

direction, while the first and second throttle bodies 9A, 9B are connected to each other by means of a second connection plate 12 on an another side (in this embodiment, on a lower side in FIG. 2) in the vehicle widthwise direction.

[0018] Referring to FIG. 2 to FIG. 4 together, the opening degree of a first air intake passage 13A included in the first throttle body 9A is controlled by a first throttle valve 14A, and the first throttle valve 14A is fixedly attached to a first valve shaft 15A which is turnably supported by the first throttle body 9A in a way that the first valve shaft 15A traverses the first air intake passage 13A. In addition, the opening degree of a second air intake passage 13B included in the second throttle body 9B is controlled by a second throttle valve 14B, and the second throttle valve 14B is fixedly attached to a second valve shaft 15B which is turnably supported by the second throttle body 9B in a way that the second valve shaft 15B traverses the second air intake passage 13B. The first and second throttle bodies 9A, 9B connected together are arranged between the first and second banks BA, BB in a way that: turn axis lines T1, T2 of the first and second throttle valves 14A, 14B, namely center axis lines of the first and second valve shafts 15A, 15B, extend in the vehicle widthwise direction; and the first and second air intake passages 13A, 13B extend in a top-bottom direction.

[0019] Furthermore, as clearly shown in FIG. 2, the first and second throttle bodies 9A, 9B are arranged by offsetting a center axis line C2 of the second air intake passage 13B from a center axis line C1 of the first air intake passage 13A towards one side in the vehicle widthwise direction in a projection view obtained by projection to a horizontal plane.

[0020] The first and second throttle valves 14A, 14B are driven by an electric motor 16 which is common for the valves 14, 14B. This electric motor 16 is arranged between the first and second throttle bodies 9A, 9B, and has a rotation axis line MC which is in parallel with the turn axis lines T1, T2 of the respective first and second throttle valves 14A, 14B, as well as is interlinked with and connected to the first and second throttle valves 14A, 14B.

[0021] Moreover, at least a part of the electric motor 16 (in this embodiment, all of the electric motor 16) is placed among one ends and opposite ends of the respective first and second throttle bodies 9A, 9B in a direction orthogonal to a first virtual plane PL1 (see FIG. 3) passing through the turn axis lines T1, T2 of the first and second throttle valves 14A, 14B. In this embodiment, at least a part of the electric motor 16 (in this embodiment, all of the electric motor 16) is placed among upper and lower ends of the respective first and second throttle bodies 9A, 9B, that is to say, between a first horizontal line HL1 passing through the upper ends of the respective first and second throttle bodies 9A, 9B and a second horizontal line HL2 passing through the lower ends of the respective first and second throttle bodies 9A, 9B.

[0022] Besides, in the projection view obtained by projection to the horizontal plane, at least a part of the electric motor 16 (in this embodiment, a part of the electric motor 16) is placed within an offset range W1 in the vehicle widthwise direction between a point of intersection P1 on the one side in the vehicle widthwise direction, which is one of the points of intersection P1, P2 between the turn axis line T1 of the first throttle valve 14A and an inner surface of the first air intake passage 13A, and a point of intersection P3 on the one side in the vehicle widthwise direction, which is one of the points of intersection P3, P4 between the turn axis line T2 of the second throttle valve 14B and an inner surface of the second intake passage 13B.

[0023] The electric motor 16 is housed in a motor housing portion 17a which is provided continuously to the first throttle body 9A on the one side in the vehicle widthwise direction and which sticks out beyond the second throttle body 9B to the one side in the vehicle widthwise direction in the projection view obtained by projection to the horizontal plane.

[0024] A tubular case main body 17 a part of which forms the motor housing portion 17a is connected to the first throttle body 9A, for example by fastening or the like, in a way that the case main body 17 sticks out beyond the first throttle body 9A to the one side in the vehicle widthwise direction. A housing case 20 is formed from: the case main body 17; and a cover member 18 fastened to the case main body 17 by means of multiple screw members 19, 19, ... in a way that closes an outer end opening portion of the case main body 17.

[0025] One end portion of the first valve shaft 15A on the one side in the vehicle widthwise direction is protruded into the inside of the housing case 20. A speed reducing gear mechanism 22 is provided between the electric motor 16 housed in the motor housing portion 17a and the first valve shaft 15A. The speed reducing gear mechanism 22 is housed in the inside of the housing case 20 as well.

[0026] As shown in FIG. 4, the speed reducing gear mechanism 22 is formed from: a driving gear 24 fixed to a motor shaft 23 of the electric motor 16; a first idle gear 25 in mesh with the driving gear 24; a second idle gear 26 rotating integrally with the first idle gear 25; and a sector gear 27 fixed to one end portion of the first valve shaft 15A in a way that the sector gear 27 is in mesh with the second idle gear 26. The first and second idle gears 25, 26 are rotatably supported by an idle shaft 28 which is provided between the case main body 17 and the cover member 18.

[0027] Furthermore, the first throttle valve 14A is biased in a closing direction by a first coil spring 29 which is a torsion spring. The first coil spring 29 provided between the housing case 20 and the sector gear 27 is housed in the inside of the housing case 20 in a way that surrounds the first valve shaft 15A. In other words, the first coil spring 29 is placed at one side of the first throttle body 9A in the vehicle widthwise direction.

[0028] Turning attention to FIG. 4, a first straight line L1, which joins the turn axis line T1 of the first throttle valve 14A and the rotation axis line MC of the electric motor 16 in a side view, obliquely intersects with a second virtual plane PL2, which is orthogonal to the center axis line C1 of the first air intake passage 13A and passes through the turn axis line T1 of the first throttle valve 14A in the side view, at an angle α to the cylinder head 7A side of the first bank BA (in this embodiment, to the lower side). The rotation axis line MC of the electric motor 16 is placed closer to the cylinder head 7A of the first bank BA (in this embodiment, in a lower side) than the second virtual plane PL2.

[0029] The opposite end portion of the first valve shaft 15A projects from the first throttle body 9A on the opposite side in the vehicle widthwise direction, and a first lever 31 is fixed to the opposite end portion of the first valve shaft 15A. In addition, an end portion of the second valve shaft 15B projects from the second throttle body 9B on the opposite side in the vehicle widthwise direction, and a second lever 32 is fixed to the end portion of the second valve shaft 15B which projects from the second throttle body 9B. Moreover, the second throttle valve 14B is biased in the closing direction by a second coil spring 30 which is a torsion spring. The second coil spring 30 to be provided between the second lever 32 and the second throttle body 9B is placed between the second lever 32 and the second throttle body 9B while surrounding the second valve shaft 15B. In other words, the second coil spring 30 is placed at the side of the second throttle body 9B in the vehicle widthwise direction, which is a side opposite from a side on which the electric motor 16 is placed.

[0030] One end portion of a link 33 is connected to the first lever 31 at a position offset from the center axis line of the first valve shaft 15A, and a link-movement mechanism 34 for turning the second lever 32 and the second valve shaft 15B in response to a longitudinal movement of the link 33 which takes place in connection with the turn of the first valve shaft 15A and the first lever 31 is provided between the opposite end portion of the link 33 and the second lever 32.

[0031] A case-side fastening portion 35 sticking out beyond the cover member 18 towards the second throttle body 9B is integrally provided to an outer end part, of a portion forming the motor housing portion 17a, of the case main body 17 connected to the first throttle body 9A. The second throttle body 9B is integrally provided with, for example, two arm-shaped fastening portions 36, 37 which project toward the one side in the vehicle widthwise direction. The first connection plate 11 is fastened to the arm-shaped fastening portions 36, 37 and the case-side fastening portion 35 by means of bolts 38, 38, ...

[0032] The second connection plate 12 is placed in a way that covers the first lever 31, the second lever 32, the link 33 and the link-movement mechanism 34 from the lateral side. The second connection plate 12 is connected by means of bolts 43, 43, ... to: paired arm-shaped

fastening portions 39, 40 integrally provided to the first throttle body 9A and projecting to the opposite side in the vehicle widthwise direction; and paired arm-shaped fastening portions 41, 42 integrally provided to the second throttle body 9B and projecting to the opposite side in the vehicle widthwise direction.

[0033] From the second throttle body 9B side, a first fuel injection valve 44A is attached to the first throttle body 9A. From the first throttle body 9A side, a second fuel injection valve 44B is attached to the second throttle body 9B. The first fuel injection valve 44A is attached to the first throttle body 9A while, in the projection view obtained by projection to the horizontal plane, being orthogonal to the turn axis line T1 of the first throttle valve 14A and having a center axis line F1 passing through the center axis line C1 of the first air intake passage 13A, and in a way that the first fuel injection valve 44A injects fuel downstream of the first throttle valve 14A. The second fuel injection valve 44B is attached to the second throttle body 9B while, in the projection view, being orthogonal to the turn axis line T2 of the second throttle valve 14B and having a center axis line F2 passing through the center axis line C2 of the second air intake passage 13B, and in a way that the second fuel injection valve 44B injects fuel downstream of the second throttle valve 14B.

[0034] In addition, the first fuel injection valve 44A is placed between the one ends and the opposite ends of the respective first and second throttle bodies 9A, 9B, that is to say, between the first and second horizontal lines HL1, HL2, in the direction orthogonal to the first virtual plane PL1 passing through the turn axis lines T1, T2 of the respective first and second throttle valves 14A, 14B, with at least part of the first fuel injection valve 44A overlapping the electric motor 16 or the motor housing portion 17a (in this embodiment, only the motor housing portion 17a) in a side view in the vehicle widthwise direction. The second fuel injection valve 44B is also placed between the one ends and the opposite ends of the respective first and second throttle bodies 9A, 9B, that is to say, between the first and second horizontal lines HL1, HL2, in the direction orthogonal to the first virtual plane PL1.

[0035] Furthermore, as shown in FIG. 2, in the projection view obtained by projection to the horizontal plane, either an opposite end portion of the electric motor 16 in the vehicle widthwise direction or an opposite end wall 17aa of the motor housing portion 17a in the vehicle widthwise direction, particularly the opposite end wall 17aa of the motor housing portion 17a in this embodiment is placed within a range W2 between the first fuel injection valve 44A and the point of intersection P1 on the one side in the vehicle widthwise direction, which is one of the points of intersection P1, P2 between the turn axis line T1 of the first throttle valve 14A and the inner surface of the first air intake passage 13A.

[0036] The second fuel injection valve 44B is placed in a location offset from the first fuel injection valve 44A towards the one side in the vehicle widthwise direction

by a distance corresponding to the amount of offset between the center axis lines C1, C2 of the respective first and second air intake passages 13A, 13B in the vehicle widthwise direction. A joint 45 having a fuel supply connecting pipe 46, which is common between the first and second fuel injection valves 44A, 44B, is attached to the first and second fuel injection valves 44A, 44B.

[0037] A fuel supply pipe 47 for supplying fuel from a fuel tank, which is not illustrated, to the first and second fuel injection valves 44A, 44B is connected to the fuel supply connecting pipe 46.

[0038] Meanwhile, in the side view, as indicated with a chain line in FIG. 1, a vacant space S is formed among mutually-adjacent upper end portions of the respective first and second throttle bodies 9A, 9B, an upper end of the first connection plate 11 and an upper end of the housing case 20, on the basis of the design in which the first straight line L1 joining, in the side view, the rotation axis line MC of the electric motor 16, which is placed under the second virtual plane PL2, and the turn axis line T1 of the first throttle valve 14A obliquely intersects, at the angle α , with the second virtual plane PL2 which is orthogonal to the center axis line C1 of the first air intake passage 13A and passing through the turn axis line T1 of the first throttle valve 14A in the side view. The fuel supply pipe 47 is laid in a way that passes the vacant space S.

[0039] Next, descriptions will be provided for operations of this embodiment. The electric motor 16 is placed between the first throttle body 9A including the first air intake passage 13A and the second throttle body 9B including the second air intake passage 13B. For this reason, the air intake system 8 can be made compact in a direction in which the first and second throttle bodies 9A, 9B are arranged (hereinafter referred to as an "arrangement direction"), compared with an air intake system having the electric motor 16 outside the two throttle bodies 9A, 9B. In addition, the placement of the electric motor 16, which is a heavy object, in the center portion of the air intake system 8 in the arrangement direction makes it possible to reduce the vibration of the air intake system 8 to a lower level.

[0040] Furthermore, in the projection view obtained by projection to the horizontal plane, the center axis line C2 of the second air intake passage 13B is offset from the center axis line C1 of the first air intake passage 13A towards the one side in the vehicle widthwise direction; at least the part (in this embodiment, only the part) of the electric motor 16 is placed within the range W1 of the offset in the vehicle widthwise direction between the point of intersection P1 on the one side in the vehicle widthwise direction, which is one of the points of intersection P1, P2 between the turn axis line T1 of the first throttle valve 14A and the inner surface of the first air intake passage 13A, and the point of intersection P3 on the one side in the vehicle widthwise direction, which is one of the points of intersection P3, P4 between the turn axis line T2 of the second throttle valve 14B and the inner surface of

the second air intake passage 13B; the first coil spring 29 for biasing the first throttle valve 14A in the closing direction is placed at the side of the first throttle body 9A in the vehicle widthwise direction, which is the side on which the electric motor 16 is placed; and the second coil spring 30 for biasing the second throttle valve 14B in the closing direction is placed at the side of the second throttle body 9B in the vehicle widthwise direction, which is the side opposite from the side on which the electric motor 16 is placed. For these reasons, the air intake system 8 can be made compact in the vehicle widthwise direction, and the layout for placing the air intake system 8 between the first and second banks BA, BB of the V-type engine can be made easier. Moreover, since the first coil spring 29 is placed at the side of the first throttle body 9A in the vehicle widthwise direction, which is the side on which the electric motor 16 is placed, it is possible to reduce or eliminate distortional deformation of the first valve shaft 15A, which is provided with the first throttle valve 14A, due to a force acting on the first valve shaft 15A from the first coil spring 29 for biasing the first throttle valve 14A in the closing direction and from the electric motor 16.

[0041] In addition, at least a part (in this embodiment, all) of the electric motor 16 is placed among the one ends and the opposite ends of the respective first and second throttle bodies 9A, 9B in the direction orthogonal to the first virtual plane PL1 passing through the turn axis lines T1, T2 of the respective first and second throttle valves 14A, 14B, that is to say, between the first horizontal line HL1 passing through the upper ends of the respective first and second throttle bodies 9A, 9B and the second horizontal line HL2 passing through the lower ends of the respective first and second throttle bodies 9A, 9B in this embodiment. For this reason, the air intake system 8 can be made compact in an air intake flow direction of each of the first and second air intake passages 13A, 13B. Thereby, also with this configuration, the layout for placing the air intake system 8 between the first and second banks BA, BB can be made easier.

[0042] What is more, the first fuel injection valve 44A injects fuel downstream of the first throttle valve 14A while, in the projection view obtained by projection to the horizontal plane, being orthogonal to the turn axis line T1 of the first throttle valve 14A and having the center axis line F1 passing through the center axis line C1 of the first air intake passage 13A. The second fuel injection valve 44B injects fuel downstream of the second throttle valve 14B while, in the projection view, being orthogonal to the turn axis line T2 of the second throttle valve 14B and having the center axis line F2 passing through the center axis line C2 of the second air intake passage 13B. By these, the performance of the engine, which depends on the fuel injection by the first and second fuel injection valves 44A, 44B, can be maintained. In addition, the first and second fuel injection valves 44A, 44B are placed among the one ends and the opposite ends of the respective first and second throttle bodies 9A, 9B in the direction orthogonal to the first virtual plane PL1 passing

through the turn axis lines T1, T2 of the respective first and second throttle valves 14A, 14B. By this, the air intake system 8 can be made compact in the air intake flow direction of each of the first and second air intake passages 13A, 13B.

[0043] Furthermore, the first fuel injection valve 44A is placed with at least a part of the first fuel injection valve 44A overlapping the electric motor 16 or the motor housing portion 17a in the side view in the vehicle widthwise direction. For this reason, the placement of the second fuel injection valve 44B closer to the electric motor 16 or the motor housing portion 17a in the direction in which the first and second throttle bodies 9A, 9B are arranged makes it possible to make the air intake system 8 compact in the direction in which the first and second throttle bodies 9A, 9B are arranged.

[0044] In the projection view obtained by projection to the horizontal plane, either the opposite end portion of the electric motor 16 in the vehicle widthwise direction or the opposite end wall 17aa of the motor housing portion 17a in the vehicle widthwise direction (in this embodiment, the opposite end wall 17aa of the motor housing portion 17a) is placed between the first fuel injection valve 44A and the point of intersection P1 on the one side in the vehicle widthwise direction, which is one of the points of intersection P1, P2 between the turn axis line T1 of the first throttle valve 14A and the inner surface of the first air intake passage 13A. Either the electric motor 16 or the motor housing portion 17a (in this embodiment, the motor housing portion 17a) is placed closer to the first fuel injection valve 44A. By these, the air intake system 8 can be made compact in the vehicle widthwise direction. Moreover, from the second throttle body 9B side, the first fuel injection valve 44A is attached to the first throttle body 9A, and from the first throttle body 9A side, the second fuel injection valve 44B is attached to the second throttle body 9B. For this reason, the air intake system 8 can be made compact in the direction in which the two throttle bodies 9A, 9B are arranged, compared with an air intake system in which at least one of the first and second fuel injection valves 44A, 44B is attached to at least a corresponding one of the two throttle bodies 9A, 9B from an opposite side of the corresponding one from the other one.

[0045] Additionally, the first straight line L1, which joins the turn axis line T1 of the first throttle valve 14A and the rotation axis line MC of the electric motor 16 in the side view in the vehicle widthwise direction, obliquely intersects with the second virtual plane PL2, which is orthogonal to the center axis line C1 of the first air intake passage 13A and passes through the turn axis line T1 of the first throttle valve 14A in the side view, at the angle α to the cylinder head 7A side of the first bank BA (in this embodiment, to the lower side). For this reason, the second fuel injection valve 44B can be placed closer to the motor housing portion 17a by using the space which is created on an opposite side of the second virtual plane PL2 from the first straight line L1, and the air intake sys-

tem 8 can be made compact in the direction in which the first and second throttle bodies 9A, 9B are arranged.

[0046] What is more, the tubular case main body 17 is connected to the first throttle body 9A in the way that a part of the case main body 17 forms the motor housing portion 17a; the cover member 18 which, together with the case main body 17, forms the housing case 20 for housing the first coil spring 29, is fastened to the case main body 17 in the way that closes the outer end opening portion of the case main body 17; the case-side fastening portion 35 sticking out beyond the cover member 18 towards the second throttle body 9B is integrally provided in the outer end part of the portion, of the case main body 17, forming the motor housing portion 17a; and the first connection plate 11 is fastened to, for example, the case-side fastening portion 35 and the paired arm-shaped fastening portions 36, 37 which are integrally provided to the second throttle body 9B and stick out towards the one side in the vehicle widthwise direction. For these reasons, by use of the simple structure which needs no specialized arm-shaped fastening portion for fastening the first connection plate 11 to be projectingly provided to the first throttle body 9A, in the projection view obtained by projection to the horizontal plane, the end portion of the second throttle body 9B on the one side in the vehicle widthwise direction can be accommodated within a range in the vehicle widthwise direction which reaches an outer end of the cover member 18, that is to say, inside the second straight line L2 extending in the front-rear direction while passing through the outer end of the cover member 18. Moreover, since the distance from the second throttle body 9B to the case-side fastening portion 35 is short, and since the motor housing portion 17a in which to house the electric motor 16 is placed in the vicinity of the case-side fastening portion 35, the second throttle body 9B is capable of effectively reducing the amplitude of vibration of the electric motor 16 and the motor housing portion 17b which occurs due to the vibration of the vehicle body; and the first connection plate 11 can be made smaller.

[0047] In addition, in the side view, the fuel supply pipe 47 for supplying the fuel to the first and second fuel injection valves 44A, 44B passes through the vacant space S which is created among the mutually-adjacent upper end portions of the respective first and second throttle bodies 9A, 9B, the upper end of the first connection plate 11 and the upper end of the housing case 20. For this reason, the fuel supply pipe 47 can be laid out with better space efficiency.

[0048] Although the foregoing descriptions have been provided for an embodiment of the present invention, the present invention is not limited to the above-described embodiment. Various design modifications may be made without departing from the present invention recited in claims.

[0049] For example, although the foregoing descriptions have been provided for the embodiment in which the engine main body 6 in the V-type twin-cylinder con-

figuration is mounted on the vehicle while including the first and second banks BA, BB which separate from each other in the front-rear direction, the present invention imposes no restriction on the orientation in which the engine main body is mounted on the vehicle as long as the turn axis lines of the respective first and second throttle valves 14A, 14B extend in the vehicle width widthwise direction.

[0050] In an air intake system of a V-type engine for a vehicle, a pair of throttle bodies connected to each other and placed between a pair of banks includes throttle valves, respectively, and an electric motor is interlinked with and connected to the throttle valves. At least part of an electric motor (16) placed between first and second throttle bodies (9A, 9B) is placed within a range (W1) of offset in a vehicle widthwise direction between points of intersection (P1, P3) on the one side in the vehicle widthwise direction, which are points of intersection between turn axis lines (T1, T2) of first and second throttle valves (14A, 14B) and inner surfaces of first and second air intake passages (13A, 13B), respectively, and is also placed among one ends and opposite ends of the respective first and second throttle bodies (9A, 9B) in a direction orthogonal to a virtual plane passing through the turn axis lines (T1, T2). A first coil spring (29) is placed at one side of the first throttle body (9A) in the vehicle widthwise direction, and a second coil spring (30) is placed at a side of the second throttle body (9B), which is a side opposite from the side on which the electric motor (16) is placed. Accordingly, the air intake system can be made compact.

Claims

1. An air intake system of a V-type engine for a vehicle in which: a first throttle body (9A) and a second throttle body (9B) are placed between first and second banks (BA, BB) in a V configuration which are provided to an engine main body (6) mounted on a vehicle, the first throttle body (9A) including a first air intake passage (13A) and a first throttle valve (14A) for opening and closing the first air intake passage (13A), the first throttle body (9A) corresponding to the first bank (BA), the second throttle body (9B) including a second air intake passage (13B) and a second throttle valve (14B) for opening and closing the second air intake passage (13B), the second throttle body (9B) corresponding to the second bank (BB), the first throttle body (9A) and the second throttle body (9B) being connected to each other, and turn axis lines (T1, T2) of the respective first and second throttle valves (14A, 14B) extending in a vehicle widthwise direction; and an electric motor (16) which is common between the first and second throttle valves (14A, 14B) has a rotation axis line (MC) in parallel with the turn axis lines (T1, T2) of the respective first and second throttle valves (14A, 14B), and is interlinked with and connected to the first and sec-

ond throttle valves (14A, 14B),

characterized in that

in a projection view obtained by projection to a horizontal plane, the first and second throttle bodies (9A, 9B) are placed with a center axis line (C2) of the second air intake passage (13B) offset from a center axis line (C1) of the first air intake passage (13A) toward one side in the vehicle widthwise direction, in the projection view, at least part of the electric motor (16) placed between the first and second throttle bodies (9A, 9B) is placed within a range (W1) of offset in the vehicle widthwise direction between a point of intersection (P1) on the one side in the vehicle widthwise direction and a point of intersection (P3) on the one side in the vehicle widthwise direction, the point of intersection (P1) being one of points of intersection (P1, P2) between the turn axis line (T1) of the first throttle valve (14A) and an inner surface of the first air intake passage (13A), and the point of intersection (P3) being one of points of intersection (P3, P4) between the turn axis line (T2) of the second throttle valve (14B) and an inner surface of the second air intake passage (13B),

at least the part of the electric motor (16) is placed among one ends and opposite ends of the respective first and second throttle bodies (9A, 9B) in a direction orthogonal to a virtual plane (PL1) passing through the turn axis lines (T1, T2) of the respective first and second throttle valves (14A, 14B),

a first coil spring (29) for biasing the first throttle valve (14A) in a closing direction is placed at one side of the first throttle body (9A) in the vehicle widthwise direction, and

a second coil spring (30) for biasing the second throttle valve (14B) in a closing direction is placed at a side of the second throttle body (9B), which is a side opposite from the side on which the electric motor (16) is placed, in the vehicle widthwise direction.

2. The air intake system of a V-type engine for a vehicle according to claim 1, wherein

a first fuel injection valve (44A) for injecting fuel downstream of the first throttle valve (14A) is attached to the first throttle body (9A) from the second throttle body (9B) side in a way that: in a side view, at least part of the first fuel injection valve (44A) overlaps the electric motor (16) or a motor housing portion (17a) provided continuously to the first throttle body (9A) on the one side in the vehicle widthwise direction and housing the electric motor (16); and the first fuel injection valve (44A) is placed among the one ends and the opposite ends of the respective first and second throttle valves (9A, 9B) in a direction orthogonal to the virtual plane (PL1),

a second fuel injection valve (44B) for injecting fuel downstream of the second throttle valve (14B) is attached to the second throttle body (9B) from the first throttle body (9A) side in a way that the second fuel

injection valve (44B) is placed among the one ends and the opposite ends of the respective first and second throttle valves (9A, 9B) in the direction orthogonal to the virtual plane (PL1), and
in the projection view obtained by projection to the horizontal plane, an opposite end portion of the electric motor (16) in the vehicle widthwise direction or an opposite end wall (17aa) of the motor housing portion (17a) in the vehicle widthwise direction is placed between the first fuel injection valve (44A) and the point of intersection (P1) on the one side in the vehicle widthwise direction, which is one of the points of intersection (P1, P2) between the turn axis line (T1) of the first throttle valve (14A) and the inner surface of the first air intake passage (13A).

3. The air intake system of a V-type engine for a vehicle according to claim 2, wherein
a tubular case main body (17) a part of which forms the motor housing portion (17a) is connected to the first throttle body (9A) in a way that is open to the one side in the vehicle widthwise direction,
the first coil spring (29) is housed in a housing case (20) formed from the case main body (17) and a cover member (18) which is fastened to the case main body (17) in a way that closes an outer end opening portion of the case main body (17),
a case-side fastening portion (35) sticking out beyond the cover member (18) towards the second throttle body (9B) is integrally provided to an outer end portion of the part, which forms the motor housing portion (17a), of the case main body (17), and
a connection plate (11) is fastened to: an arm-shaped fastening portion (36, 37) integrally provided to the second throttle body (9B) and projecting to the one side in the vehicle widthwise direction; and the case-side fastening portion (35).

40

45

50

55

FIG.1

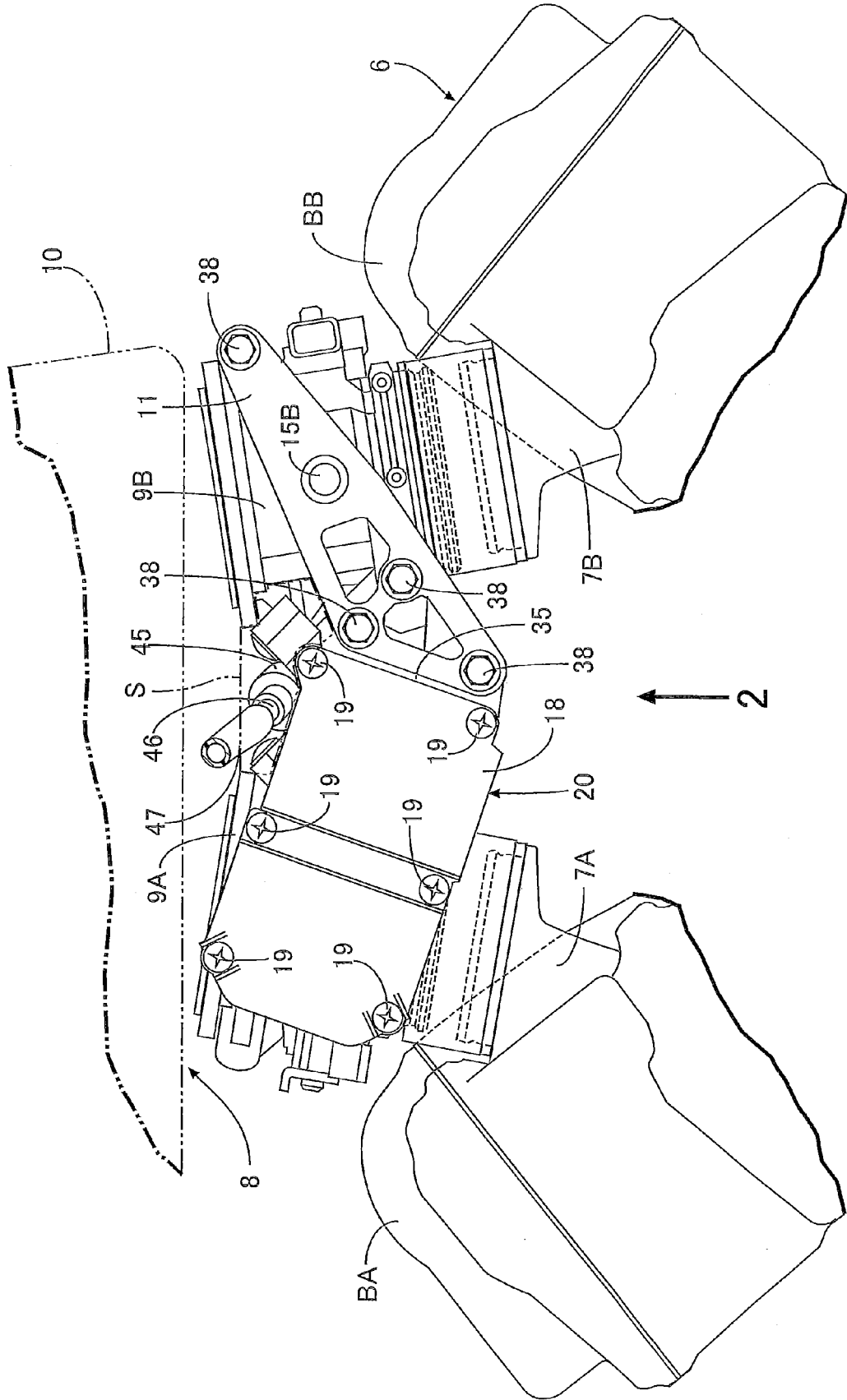


FIG.2

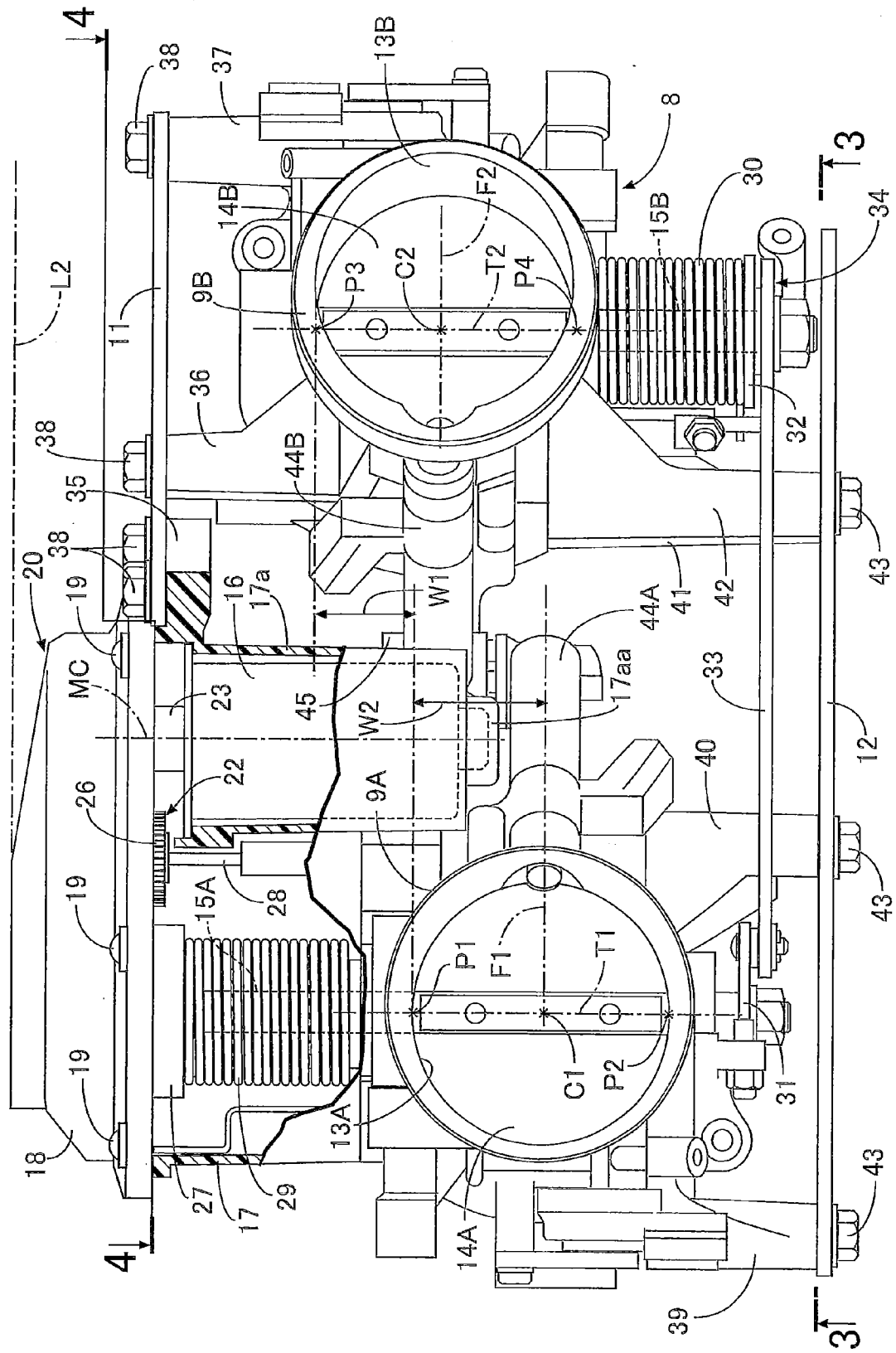
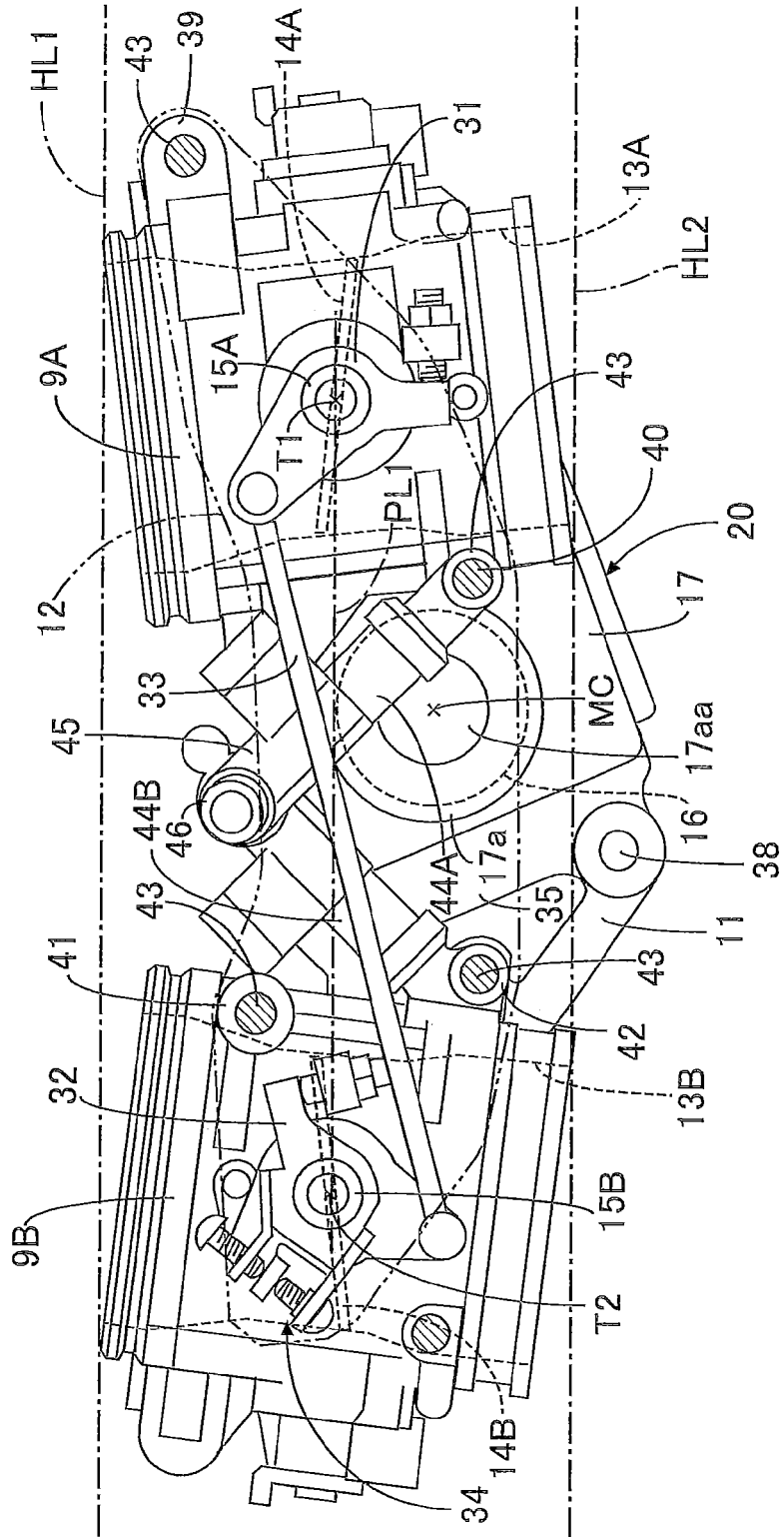


FIG.3





EUROPEAN SEARCH REPORT

Application Number
EP 13 15 2126

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	EP 1 555 409 A1 (MIKUNI KOGYO KK [JP]) 20 July 2005 (2005-07-20)	1	INV. F02D9/10 F02M35/116 F02M35/10
Y	* paragraphs [0031], [0040], [0043], [0045], [0046] * * figures 1-7 *	2	
Y	----- EP 2 048 350 A2 (YAMAHA MOTOR CO LTD [JP]) 15 April 2009 (2009-04-15) * paragraphs [0019], [0032] - [0041], [0043], [0052], [0055] - [0061] * * figures 3-5,8,9 * -----	2	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F02D F02M F02B
Place of search		Date of completion of the search	Examiner
Munich		25 April 2013	Mallo López, Manuel
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 15 2126

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-04-2013

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1555409	A1	20-07-2005	CN 1703576 A	30-11-2005
			DE 60318236 T2	18-12-2008
			EP 1555409 A1	20-07-2005
			JP 2004132290 A	30-04-2004
			US 2006231069 A1	19-10-2006
			WO 2004033876 A1	22-04-2004

EP 2048350	A2	15-04-2009	EP 2048350 A2	15-04-2009
			JP 2009092018 A	30-04-2009
			US 2009095252 A1	16-04-2009

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2009085111 A [0002] [0003]
- JP 2004132290 A [0002] [0003]