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(71) Applicant: **Mikuni Corporation**
Tokyo 101-0021 (JP)

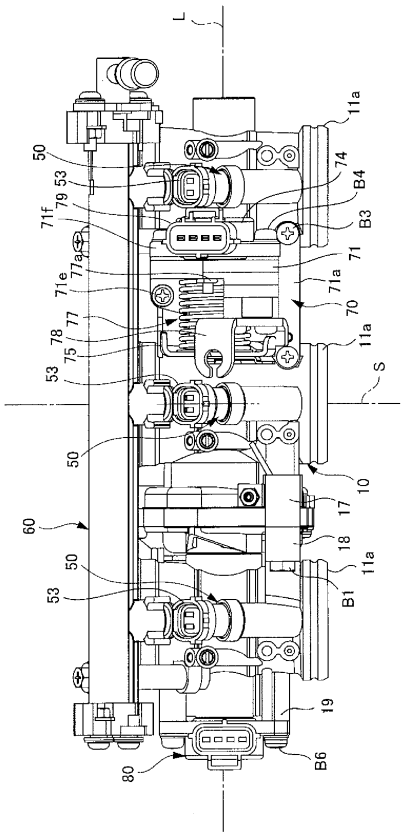
(72) Inventors:
- **HAMASAKI, Daisuke**
Odawara-shi, Kanagawa 255-0055 (JP)
- **ISHIKAWA, Michihiko**
Odawara-shi, Kanagawa 250-0055 (JP)

(74) Representative: **Schwabe - Sandmair - Marx**
Patentanwälte
Stuntzstraße 16
81677 München (DE)

(54) **THROTTLE DEVICE**

(57) A throttle device of the present invention includes a throttle body (10) which defines a plurality of throttle bores (11), a plurality of throttle valves (20), a throttle shaft (30), a drive mechanism (40) which rotationally drives the throttle shaft, a plurality of fuel injectors (50) which are arranged as being laid out at one side section of the throttle body to inject fuel into the plurality of throttle bores, and an accelerator opening detection mechanism (70) which is arranged at the throttle body to detect opening of an accelerator grip via an accelerator cable. The accelerator opening detection mechanism (70) is arranged on the same side as the one side section where the plurality of fuel injectors are laid out. Consequently, the throttle device can be easily arranged in a limited space of a motorcycle and the accelerator cable can be easily routed.

Fig.4



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Description

TECHNICAL FIELD

[0001] The present invention relates to a throttle device which is mounted on an engine installed on a motorcycle or the like, and in particular, relates to a throttle device in which open-close driving of throttle valves is performed by a drive source such as a motor or the like.

BACKGROUND ART

[0002] There has been conventionally known a throttle device including a throttle body which defines a plurality of throttle bores communicated with intake passages of an engine, a plurality of throttle valves which open and close the throttle bores, a throttle shaft which rotatably supports the plurality of throttle valves, a motor which rotationally drives the throttle shaft, a plurality of fuel injectors which are attached to the throttle body to inject fuel into the respective throttle bores, an accelerator opening detection mechanism which is attached to the opposite side to the fuel injectors as sandwiching the throttle bores to detect a rotation amount (accelerator opening) of an accelerator grip arranged at a handle bar of a motorcycle as being moved with the accelerator grip, an interlocking mechanism which interlocks the accelerator opening detection mechanism with rotation of the throttle shaft as being arranged at one end side of the throttle shaft, and the like (see Patent Literature 1).

[0003] By the way, in the case that a throttle device is a horizontal type in which throttle bores are arranged as being oriented approximately in the horizontal direction, generally, fuel injectors are located at the upper side causing accelerator opening detection mechanism located at the lower side. Accordingly, when such a throttle device is mounted on an engine of a motorcycle, an accelerator cable (outer cable, inner cable) which is connected to the accelerator opening detection mechanism is extended upward as being bent into a U-shape after being extended downward once and is connected to an accelerator grip as being routed along a frame and the like of the motorcycle .

[0004] Such layout of the accelerator cable requires a space for arrangement of a U-shaped bent portion. Further, owing to that water drops and the like entered into the accelerator cable (outer cable) are accumulated at the U-shaped portion, there is a risk of occurrence of rusting, freezing, and the like.

[0005] On the other hand, in the case of a downdraft type in which throttle bores are arranged as being oriented approximately in the vertical direction, generally, a throttle body is arranged as being close to an engine. Accordingly, such a throttle body is difficult to be attached to the engine. For attaching thereto, it is required to ensure an extra space between the throttle body and the engine for arranging one of an accelerator opening detection mechanism and fuel injectors by arranging the throttle body as being distanced from the engine to some extent. In addition, it is required to ensure an extra space at the rear side of the throttle body for arranging the other of the accelerator opening detection mechanism and the fuel injectors. Thus, it is difficult to arrange components to be aggregated around the engine.

Cited Literature

Patent Literature

[0006] Patent Literature 1: Japanese Patent Application Laid-Open No. 2007-198355

SUMMARY OF THE INVENTION

[0007] To address the above issues, an object of the present invention is to provide a throttle device which can be easily arranged in a limited space of a multi-cylinder engine specifically installed on a motorcycle or the like while achieving structural simplification, reduction in component count, component aggregation, device downsizing, and the like and in which routing of an accelerator cable connecting an accelerator grip and an accelerator opening detection mechanism can be easily performed.

[0008] An accelerator device according to the present invention includes a throttle body which defines a plurality of throttle bores, a plurality of throttle valves which open and close the plurality of throttle bores, respectively, a throttle shaft which is supported by the throttle body to integrally rotate the plurality of throttle valves, a drive mechanism which rotationally drives the throttle shaft, a plurality of fuel injectors which are arranged as being laid out at one side section of the throttle body to inject fuel into the plurality of throttle bores, and an accelerator opening detection mechanism which is arranged at the throttle body to detect opening of an accelerator grip via an accelerator cable. Here, the accelerator opening detection mechanism is arranged on the same side as the one side section where the plurality of fuel injectors are laid out.

[0009] According to the configuration, the plurality of fuel injectors and the accelerator opening detection mechanism

are arranged at one side (the same side) of the throttle body which defines the plurality of paralleled throttle bores. Accordingly, the throttle device can be downsized as a whole with aggregation of components. In addition, the other side of the throttle body can be effectively utilized when the throttle device is mounted on an engine.

[0010] Further, when the throttle device is mounted on the engine of a motorcycle, in the case of a horizontal type in which (the axis line direction of) the throttle bores are oriented approximately horizontal, the accelerator cable is not required to be bent into an upward U-shape after being extended downward once as in a conventional case, while the fuel injectors are located at the upper side. Consequently, routing of the accelerator cable can be easily performed. In addition, it is possible to prevent occurrence of rusting, freezing, and the like due to accumulation of water drops, and the like in the accelerator cable.

[0011] In the case of a downdraft type in which (the axis line direction of) the throttle bores are oriented approximately vertical, the one side (the side on which the plurality of fuel injectors and the accelerator opening detection mechanism are arranged) of the throttle body is arranged in a direction to be apart from the engine while the other side of the throttle body is arranged to be close (opposed) to the engine. Thus, aggregation of components can be achieved as a motorcycle. Further, similarly to the above, routing of the accelerator cable can be easily performed. In addition, it is possible to prevent occurrence of rusting, freezing, and the like due to accumulation of water drops, and the like in the accelerator cable.

[0012] In the above configuration, it is possible to adopt a configuration that the accelerator opening detection mechanism is arranged between the plurality of fuel injectors in a laying-out direction of the throttle bores.

[0013] According to the configuration, since the accelerator opening detection mechanism is arranged between the injectors, the accelerator opening detection mechanism can be placed to be closer to the throttle body by the amount thereof. Consequently, the throttle device can be further downsized as a whole.

[0014] In the above configuration, it is possible to adopt a configuration that the device further includes a delivery pipe which is arranged approximately in parallel with the throttle shaft to supply fuel to the plurality of fuel injectors and the accelerator opening detection mechanism is arranged between two injectors among the plurality of fuel injectors at an area which is not protruded outward from the delivery pipe in a direction of an axis line of the throttle bores.

[0015] According to the above configuration, the accelerator opening detection mechanism is arranged between the injectors so as not to be protruded outward from the delivery pipe in the axis line direction of the throttle bores. Accordingly, the throttle device can be mounted on a motorcycle having the delivery pipe as a reference of a profile of the throttle device. In addition, the throttle device can be further downsized as a whole and routing of the accelerator cable can be performed more easily.

[0016] In the above configuration, it is possible to adopt a configuration that the accelerator opening detection mechanism includes a rotating member to which an accelerator cable moving with rotation of the accelerator grip is connected, a sensor rotating shaft to which the rotating member is fixed to be integrally rotated, a holder which rotatably supports the sensor rotating shaft and which is fixed to the throttle body in a detachably attachable manner, and a sensor unit which detects a rotation angle of the sensor rotating shaft as being arranged at the holder.

[0017] According to the configuration, when the accelerator grip is rotated, the rotating member and the sensor rotating shaft are rotated via the accelerator cable, and then, accelerator opening is detected owing to that the sensor unit detects a rotational angle of the sensor rotating shaft.

[0018] Here, since the accelerator opening detection mechanism is structured with the rotating member, the sensor rotating shaft, the holder, the sensor unit, and the like, structural simplification can be achieved.

[0019] In the above configuration, it is possible to adopt a configuration that the sensor rotating shaft is rotatably supported by the holder via a bearing which includes an inner ring and an outer ring, the sensor rotating shaft includes a small-diameter portion to define a step to which the inner ring is externally fitted and to which one end part of the inner ring is abutted in the axis line direction, and the rotating member is externally fitted to the small-diameter portion and fixed to the sensor rotating shaft as sandwiching a spacer which is abutted to the other end part of the inner ring.

[0020] According to the configuration, the sensor rotating shaft is rotatably supported via the bearing and the inner ring of the bearing is firmly sandwiched by the sensor rotating shaft and the rotating member as sandwiching the spacer. Therefore, the sensor rotating shaft can be shortened and prevented from slanting (tilting), so that detection can be performed in high accuracy. Further, since the sensor rotating shaft can be short, the accelerator opening detection mechanism can be easily arranged between the fuel injectors which have a distance therebetween corresponding to a pitch of the throttle bores.

[0021] In the above configuration, it is possible to adopt a configuration that the accelerator opening detection mechanism includes a bracket which fixes an outer cable of an accelerator cable and which is fixed to the holder in a detachably attachable manner to adjust a routing direction of the accelerator cable.

[0022] According to the configuration, routing (layout) of the accelerator cable can be easily performed in accordance with various types of motorcycles by appropriately adjusting the attaching direction of the bracket.

[0023] In the above configuration, it is possible to adopt a configuration that the plurality of fuel injectors includes connectors which provide electric connection, the accelerator opening detection mechanism includes a connector which

provides electric connection, and the connectors of the fuel injectors and the connector of the accelerator opening detection mechanism are arranged to be oriented approximately in the direction.

[0024] According to the configuration, wiring of a motorcycle side to the connectors can be easily performed when the throttle device M is to be mounted on the engine of the motorcycle. Consequently, assembling can be easily performed at a manufacturing line, or the like.

[0025] According to the throttle device having the abovementioned configuration, the throttle device can be easily arranged in a limited space of a multi-cylinder engine specifically installed on a motorcycle or the like while achieving structural simplification, reduction in component count, component aggregation, device downsizing, and the like and in which routing of an accelerator cable connecting an accelerator grip and an accelerator opening detection mechanism can be easily performed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is an external side view illustrating a motorcycle provided with an engine on which a throttle device according to the present invention is mounted.

FIG. 2 is an external perspective view illustrating an embodiment of a throttle device according to the present invention.

FIG. 3 is an external perspective view illustrating the throttle device illustrated in FIG. 2 having a part of an accelerator opening detection mechanism cut out.

FIG. 4 is a plane view of the throttle device illustrated in FIG. 2.

FIG. 5 is a side view of the throttle device illustrated in FIG. 2.

FIG. 6 is a partial sectional view illustrating the accelerator opening detection mechanism which is included in the throttle device illustrated in FIG. 2.

FIG. 7 is a schematic view illustrating a state (horizontal type) that a throttle device according to the present invention is attached to a multi-cylinder engine which is installed on a motorcycle.

FIG. 8 is a schematic view illustrating a state (downdraft type) that a throttle device according to the present invention is attached to a multi-cylinder engine which is installed on a motorcycle.

EMBODIMENT OF THE INVENTION

[0027] In the following, embodiments of the present invention will be described with reference to the attached drawings.

[0028] As illustrated in FIG. 1, a throttle device is mounted on a multi-cylinder engine (here, three-cylinder engine) which is installed on a motorcycle.

[0029] As illustrated in FIG. 1, a motorcycle is provided with a multi-cylinder engine 1, a throttle device M which is mounted on a plurality of intake ports of the multi-cylinder engine 1 via a connection member 2, an intake system 3 which is connected to the upstream side of the throttle device M, an accelerator grip 4 which is roratably arranged at a handle-bar, and an accelerator cable 5 (an outer cable 5a, an inner cable 5b) which connects the accelerator grip 4 and the throttle device M.

[0030] As illustrated in FIGs. 2 to 4, the throttle device M is provided with a throttle body 10 which defines a plurality (here, three) of throttle bores 11 extending in a direction of an axis line S, a plurality (here, three) of throttle valves 20 which open and close the plurality of throttle bores 11 respectively, a throttle shaft 30 which is supported by the throttle body 10 to integrally rotate the plurality of throttle valves 20, a drive mechanism 40 which is arranged at the throttle body 10 to rotationally drive the throttle shaft 30, a plurality (here, three) of fuel injectors 50 which is arranged as being laid out at one side section (the U side) of the throttle body 10 to inject fuel into the plurality of throttle bores 11, a delivery pipe 60 which is fixed to the throttle body 10 to supply fuel to the plurality of fuel injectors 50, an accelerator opening detection mechanism 70 which is arranged at the one side section (the U side) of the throttle body 10 to detect opening of the accelerator grip 4 via the accelerator cable 5, a position sensor 80 which is arranged at one side section of the throttle body 10 to detect an opening position of the throttle valves 20, and the like.

[0031] As illustrated in FIGs. 2 to 5, the throttle body 10 includes a first body 10A and a second body 10B which are separatably connected with screws B1 for fastening.

[0032] As illustrated in FIGs. 2 to 4, the first body 10A includes two throttle bores 11 which are laid out in the direction of an axis line L of the throttle shaft 30, connection portions 11a, 11b which are formed at both ends of each throttle bore 11, bearing holes 12 which rotatably support the throttle shaft 30, two mount portions 13 to which the fuel injectors 50 are attached, a boss portion 14 to which the accelerator opening detection mechanism 70 is attached, a case portion 15 and a cover portion 16 which house the drive mechanism 40, a plurality of connection portions 17 for connecting with the second body 10B, and the like.

[0033] As illustrated in FIGs. 2 to 5, the second body 10B includes a throttle bore 11 laid out in the direction of the

axis line L of the throttle shaft 30, connection portions 11a, 11b which are formed at both ends of the throttle bore 11, bearing holes 12 which rotatably supports the throttle shaft 30, a mount portion 13 to which the fuel injector 50 is attached, a plurality of connection portions 18 for connecting with the first body 10A, a mount portion 19 to which the position sensor 80 is attached, and the like.

[0034] In the throttle body 10 in a state that the first body 10A and the second body 10B are connected, the three mount portions 13 are arranged at the one side section (the U side) of the throttle body 10 as being laid out at even intervals. The boss portion 14 is arranged at the same side as the two mount portions 13 against the throttle bores 11 of the first body 10A between the two mount portions 13.

[0035] In the throttle body 10 in the state that the first body 10A and the second body 1OB are connected, the case portion 15 and the cover portion 16 are formed at the opposite side to the side where the three mount portions 13 and the boss portion 14 are arranged as being partially protruded.

[0036] Thus, since the throttle body 10 is divided at an area where the drive mechanism 40 is placed, components (connection gears connected to the throttle shaft 30, and the like) included in the drive mechanism 40 can be easily attached to the throttle shaft 30. In addition, since the drive mechanism 40 is surrounded and housed by the case portion 15 and the cover portion 16, reliability in function can be ensured while preventing interference with other components and the like.

[0037] As illustrated in FIG. 2, the three throttle valves 20 are placed into the corresponding throttle bores 11 respectively after the throttle shaft 30 is rotatably supported by the throttle body 10, and then, is fixed to the throttle shaft 30 with screws B2. Thus, the three throttle valves 20 are configured to open and close the throttle bores 11 as being integrated with the throttle shaft 30.

[0038] The throttle shaft 30 is formed of a single shaft having a circular section. A connection gear (not illustrated) of the drive mechanism 40 is connected to the throttle shaft 30 in a detachably attachable manner in an area of the first body 10A surrounded by the case portion 15 and the cover portion 16 in the direction of the axis line L so that rotational drive force due to the drive mechanism 40 is transmitted thereto.

[0039] That is, the throttle shaft 30 is inserted to the bearing holes 12 of the first body 10A and the bearing holes 12 of the second body 10B in a state with a connection gear (not illustrated) connected thereto in advance, and then, the second body 10B is fixed to the first body 10A using screws B1. Thus, the throttle shaft 30 is supported rotatably about the axis line L against the throttle body 10.

[0040] The drive mechanism 40 is configured to rotationally drive the throttle shaft 30 as including a motor (not illustrated) which is housed in the case portion 15 and the cover portion 16, a gear train (not illustrated) for transmitting rotational force of the motor to the throttle shaft 30, the connection gear which is engaged with the gear train and connected to the throttle shaft 30, and the like.

[0041] The motor is a torque motor which generates rotational drive force (torque) as rotating within a predetermined angle range. The motor includes a motor body which is housed in the case portion 15 and the cover portion 16, a pinion which is directly connected to a rotational shaft thereof, a connector portion 41 for providing electrical connection as being fixed to the cover portion 16, and the like.

[0042] Each of the three fuel injectors 50 is configured to inject fuel toward an intake passage of an engine from the throttle bore 11 as including a body portion 51 which includes an electromagnetic valve attached to the mount portion 13 of the throttle body 10, a connection portion 52 which is connected to the delivery pipe 60, a connector 53 for providing electric connection, and the like.

[0043] That is, as illustrated in FIGs. 2 to 4, the three fuel injectors 50 are arranged at one side section (the U side) of the throttle body 10 as being laid out at even intervals in a laying-out direction of the three throttle bores 11 (the direction of the axis line L).

[0044] As illustrated in FIGs. 3 to 5, the connector 53 is oriented outward in a direction (an axis line V) approximately perpendicular to the axis line S (i.e., upward in FIG. 5).

[0045] As illustrated in FIGs. 2 to 4, the delivery pipe 60 is arranged at one side section (the U side) of the throttle body 10 where the three fuel injectors 50 are arranged as being approximately parallel to (the axis line L of) the throttle shaft 30. The delivery pipe 60 is connected to the connection portions 52 of the three fuel injectors 50 and fixed to the throttle body 10 using screws or the like.

[0046] Then, the delivery pipe 60 is configured to function as a common piping through which fuel is supplied to the respective fuel injectors 50.

[0047] As illustrated in FIGs. 2, 4 and 6, the accelerator opening detection mechanism 70 is arranged at the same side as the one side section (the U side) of the throttle body 10, that is, as the plurality of fuel injectors 50 and is arranged between two of the fuel injectors 50 in the laying-out direction of the throttle bores 11 (the direction of the axis line L).

[0048] Here, the accelerator opening detection mechanism 70 includes a holder 71 which is fixed to the boss portion 14 of the throttle body 10 using screws B3, a sensor rotating shaft 72 which is rotatably supported about an axis line L2 by the holder 71, a bearing 73 which rotatably supports a part of the sensor rotating shaft 72, a sensor unit 74 which detects a rotational angle of the sensor rotating shaft 72 as being arranged at the holder 71, a rotating member 75 which

is fixed to the sensor rotating shaft 72 as being rotated integrally therewith and to which the accelerator cable 5 moving with rotation of the accelerator grip is connected, a spacer 76 which is interposed between the rotating member 75 and the bearing 73, a return spring 77 which is held at the holder 71 to rotationally urge the rotating member 75 toward a rest position, a bracket 78 which is fixed to the holder 71 to fix the outer cable 5a of the accelerator cable 5, a connector 79 for providing electric connection of the sensor unit 74, and the like.

[0049] When the accelerator grip 4 is rotated, the rotating member 75 and the sensor rotating shaft 72 are rotated via the accelerator cable 5, and then, a rotation amount of the accelerator grip 4, that is, accelerator opening, is detected owing to that the sensor unit 74 detects a rotational angle of the sensor rotating shaft 72.

[0050] Here, since the accelerator opening detection mechanism 70 is structured with the holder 71, the sensor rotating shaft 72, the sensor unit 74, the rotating member 75, the return spring 77, the bracket 78, and the like and having the respective components aggregated around the holder 71, it is possible to achieve structural simplification, downsizing, and the like.

[0051] As illustrated in FIGs . 2 to 4 and 6, the holder 71 includes a flange portion 71a which has holes through which the screws B3 pass for fixing to the boss portion 14 of the throttle body 10, a bearing hole 71b which rotatably supports the sensor rotating shaft 72, a fitting hole 71c to which the bearing 73 is fitted, a cylinder portion 71d which holds the return spring 77 as having the return spring 77 externally fitted thereto, a locking portion 71e which locks one end part 77a of the return spring 77, a flange portion 71f which has screw holes for fixing the sensor unit 74 using screws B4, and the like.

[0052] As illustrated in FIG. 6, the sensor rotating shaft 72 includes a large-diameter portion 72a which is supported by the bearing hole 71b of the holder 71, a small-diameter portion 72b which defines a step 72b' to be supported by the bearing 73, a fixing portion 72c to which the rotating member 75 is fitted in a manner of being incapable of rotating as being formed to have a smaller diameter than that of the small-diameter portion 72b and to which a nut 72c" is screwed with a washer 72c' passed through therethrough, a connection portion 72d to which a part of the sensor unit 74 is connected, and the like.

[0053] As illustrated in FIG. 6, the bearing 73 includes an inner ring 73a which is fitted to the small-diameter portion 72b of the sensor rotating shaft, an outer ring 73b which is fitted to the fitting hole 71c of the holder 71, a plurality of rolling elements 73c which is interposed between the inner ring 73a and the outer ring 73b in a manner of being capable of rolling, and the like.

[0054] Here, as illustrated in FIG. 6, the inner ring 73a is arranged to be externally fitted to the small-diameter portion 72b while one end part thereof is abutted to the step 72b' and the other end part thereof is abutted to the spacer 76 in the direction of the axis line L2.

[0055] The sensor unit 74 includes a movable portion (not illustrated) which is connected to the connection portion 72d of the sensor rotating shaft 72 and a fixed portion. The sensor unit 74 is configured to detect a rotational angle of the sensor rotating shaft 72 by detecting a relative movement amount between the movable portion and the fixed portion with a contact type (potentiometer, or the like) or a non-contact type (magnetic sensor, or the like).

[0056] As illustrated in FIGs. 2 to 6, the rotating member 75 includes an approximately rectangular fitting hole 75a externally fitted to the fixing portion 72c, a drum portion 75b to which the inner cable 5b of the accelerator cable 5 is wound, a locking portion 75c which locks the other end part 77b of the return spring 77, an abutting portion 75d which is abutted to a stopper 78b of the bracket 78, and the like.

[0057] As illustrated in FIG. 6, the spacer 76 is arranged to be externally fitted to the small-diameter portion 72b of the sensor rotating shaft 72 while one end part thereof is abutted to the other end part of the inner ring 73a and the other end part thereof is abutted to one side face of the rotating member 75 in the direction of the axis line L2.

[0058] The rotating member 75 is externally fitted to the fixing portion 72c of the sensor rotating shaft 72 as sandwiching the spacer 76 which is externally fitted to the small-diameter portion 75b and is abutted to the other end part of the inner ring 73a. Then, the rotating member 75 is fixed to the sensor rotating shaft 72 using the washer 72c' and the nut 72c".

[0059] Here, the sensor rotating shaft 72 is rotatably supported by the holder 71 via the bearing 73 and the inner ring 73a of the bearing 73 is firmly sandwiched by the sensor rotating shaft 72 and the rotating member 75 as sandwiching the spacer 76. Therefore, the sensor rotating shaft 72 can be shortened and prevented from slanting (tilting), so that detection can be performed in high accuracy. Further, since the sensor rotating shaft 72 can be short, the accelerator opening detection mechanism 70 can be easily arranged between the fuel injectors 50 which have a distance therebetween corresponding to a pitch of the throttle bores 11.

[0060] As illustrated in FIG. 2 to 6, the return spring 77 is a torsion-type coil spring and is held as being fitted to the cylinder portion 71d of the holder 71. The return spring 77 is locked at the locking portion 71e of the holder 71 at the one end part 77a thereof and is locked by the locking portion 75c of the rotating member 75 at the other end part 77b thereof. Thus, the return spring 77 is configured to exert urging force so that the rotating member 75 and the sensor rotating shaft 72 are rotated and returned to the predetermined rest position.

[0061] As illustrated in FIGs. 2, 4 and 5, the bracket 78 is fixed to the holder 71 using screws B5 in a detachably attachable manner. The bracket 78 includes a fixing portion 78a which fixes the outer cable 5a of the accelerator cable

5 and the stopper 78b which stops the rotating member 75 at the rest position as being abutted to the abutting portion 75d.

[0062] The fixing portion 78a functions to perform orienting of an extension direction of the accelerator cable 5 when extending toward the accelerator grip. As illustrated in FIG. 5, the fixing portion 78a is formed so that the accelerator cable 5 is guided as being inclined by a predetermined angle against a direction (axis line V) perpendicular to the axis line S toward the R side.

[0063] Here, the bracket 78 is formed to be fixedly attached to the holder 71 at a predetermined angle. However, it is also possible that the bracket 78 is formed so that the inclination angle against the holder 71 is adjustable to adjust the wiring direction (extending direction) of the accelerator cable 5.

[0064] In this case, routing (layout) of the accelerator cable 5 can be easily performed in accordance with various types of motorcycles by appropriately adjusting the attaching direction of the bracket 78.

[0065] The connector 79 provides electric connection of the accelerator opening detection mechanism 70 (sensor unit 74). As illustrated in FIGs. 3 to 5, the connector 79 is oriented outward in the direction (axis line V) approximately perpendicular to the axis line S (i.e., upward in FIG. 5).

[0066] That is, the connector 79 of the accelerator opening detection mechanism 70 and the connectors 53 of the fuel injectors 50 are oriented in approximately the same direction (outward as being approximately perpendicular to the axis line S).

[0067] Accordingly, wiring of a motorcycle side to the connectors 79, 53 can be easily performed when the throttle device M is to be mounted on the engine 1 of the motorcycle. Consequently, assembling can be easily performed at a manufacturing line, or the like.

[0068] Since the accelerator opening detection mechanism 70 having the abovementioned structure is arranged between two injectors 50 among the plurality of fuel injectors 50 in the laying-out direction of the throttle bores 11, the accelerator opening detection mechanism 70 can be placed to be closer to the throttle body 10 by the amount thereof. Consequently, the throttle device M can be further downsized as a whole.

[0069] Further, as illustrated in FIG. 5, the accelerator opening detection mechanism 70 is arranged between two injectors among the plurality of fuel injectors 50 at an area which is not protruded outward from the delivery pipe 60 in the direction of the axis line S of the throttle bores 11. Accordingly, since the throttle device M can be mounted on a motorcycle having the delivery pipe 60 as a reference of a profile of the throttle device M, layout designing in the motorcycle can be easily performed. In addition, the throttle device M can be further downsized as a whole and routing of the accelerator cable 5 can be performed more easily.

[0070] The position sensor 80 detects a rotational angle of the throttle shaft 30. As illustrated in FIGs. 2 to 5, the position sensor 80 includes a sensor body portion 81 which is fixed to the mount portion 19 using screws B6, and a connector 82 which is oriented outward (approximately upward in FIG. 5) in the direction (axis line V) approximately perpendicular to the axis line S as being integrally formed with the sensor body portion 81.

[0071] A contact-type or non-contact type sensor can be adopted as the sensor body portion 81 as long as being capable of detecting a rotational angle of the throttle shaft 30.

[0072] The connector 82 is oriented in approximately the same direction (outward as being approximately perpendicular to the axis line S) along with the connector 79 of the accelerator opening detection mechanism 70 and the connectors 53 of the fuel injectors 50. Accordingly, similarly to the connectors 79, 53, wiring of a motorcycle side to the connector 82 can be easily performed when the throttle device M is to be mounted on the engine 1 of the motorcycle. Consequently, assembling can be easily performed at a manufacturing line, or the like.

[0073] As described above, according to the throttle device M having the abovementioned structure, the plurality of fuel injectors 50 and the accelerator opening detection mechanism 70 are arranged at one side (the same side) of the throttle body 10 against the throttle bores 11. Accordingly, the throttle device M can be downsized as a whole with aggregation of components. In addition, the other side of the throttle body 10 can be effectively utilized when the throttle device M is to be mounted on an engine.

[0074] Further, advantages of the abovementioned throttle device M will be described.

[0075] First, in the case that the abovementioned throttle device M is mounted on an engine 1 of a motorcycle so that the throttle bores 11 are oriented approximately horizontal (i.e. , a horizontal type) as illustrated in FIG. 7, the accelerator cable 5 can be connected to the accelerator grip 4 as being directly extended upward while the fuel inj ectors 50 are located at the upper side of the motorcycle as illustrated in FIG. 1. Accordingly, the accelerator cable 5 is not required to be bent into an upward U-shape after being extended downward once as in a conventional case. Consequently, routing of the accelerator cable 5 can be easily performed. In addition, it is possible to prevent occurrence of rusting, freezing, and the like due to accumulation of water drops, and the like in the accelerator cable 5 (outer cable 5a).

[0076] On the other hand, in the case that the abovementioned throttle device M is mounted on an engine 1 of a motorcycle so that the throttle bores 11 are oriented approximately vertical or oblique (i.e., a downdraft type) as illustrated in FIG. 8, the one side (the side on which the plurality of fuel injectors 50 and the accelerator opening detection mechanism 70 are arranged / the U side) of the throttle body 10 is arranged in a direction to be apart from the engine 1 (rearward from the motorcycle) while the other side (the D side) of the throttle body 10 is arranged to be close (opposed) to the

engine 1. Thus, aggregation of components can be achieved as a motorcycle. Further, similarly to the above, routing of the accelerator cable 5 can be easily performed. In addition, it is possible to prevent occurrence of rusting, freezing, and the like due to accumulation of water drops, and the like in the accelerator cable 5 (outer cable 5a).

[0077] Next, operation of the abovementioned throttle device will be briefly described.

[0078] First, in a state that the accelerator grip 4 is returned to the rest position, the accelerator opening detection mechanism 70 detects that accelerator opening is zero (at the rest position) via the accelerator cable 5. At that time, the drive mechanism 40 locates the throttle shaft 30 and the throttle valves 20 at a rest position (idle opening or default opening being slightly larger than the idle opening).

[0079] Further, the position sensor 80 detects an angle position of the throttle shaft 30 which is at the rest position and feeds back the detection signal to a control circuit of the drive mechanism 40.

[0080] When the accelerator grip 4 is rotated as required, a rotation amount (accelerator opening) thereof is detected by the accelerator opening detection mechanism 70 via the accelerator cable 4, and then, the detection signal is transmitted to the control circuit. The drive mechanism 40 is driven and controlled based on a control signal transmitted from the control circuit, so that the throttle shaft 30 and the throttle valves 20 are rotated to an angle position corresponding to the rotation amount of the accelerator grip 4.

[0081] Then, air flows toward the F side from the R side through the throttle bores 11 in accordance with the opening of the throttle valves 20 and fuel is injected from the fuel injectors 50 as required.

[0082] Further, the position sensor 80 detects the angle position of the throttle shaft 30 in this state and feeds back the detection signal to the control circuit.

[0083] On the other hand, when the accelerator grip 4 is returned to the rest position, a rotation amount (accelerator opening) thereof is detected by the accelerator opening detection mechanism 70 via the accelerator cable 4, and then, the detection signal is transmitted to the control circuit. The drive mechanism 40 is driven and controlled based on a control signal transmitted from the control circuit, so that the throttle shaft 30 and the throttle valves 20 are located at the rest position (the idle opening or the default opening being slightly larger than the idle opening).

[0084] Further, the position sensor 80 detects the angle position of the throttle shaft 30 in this state and feeds back the detection signal to the control circuit.

[0085] As described above, according to the throttle device M, open-close driving of the throttle valves 20 (and the throttle shaft 30) is performed not by the accelerator cable 5 directly but by the drive mechanism 40 and the accelerator cable 5 is connected to the accelerator opening detection mechanism 70 to detect accelerator opening. Accordingly, it is possible that a motorcycle having a multi-cylinder engine on which a throttle device which performs open-close driving of throttle valves directly by the accelerator cable 5 is modified to have a configuration to perform open-close driving of the throttle valves 20 with the drive mechanism 40 by replacing only the throttle device with the throttle device M of the present invention while using the accelerator grip 4 and the accelerator cable 5 without change.

[0086] In the above description of the abovementioned embodiment, three of the throttle valves 20 and three throttle bores 11, and three of the fuel injectors 50 are adopted as the plurality of throttle valves and throttle bores and the plurality of fuel injectors. However, not limited to this, the configuration of the present invention can be adopted to a configuration having two or four or more throttle valves, throttle bores, and fuel injectors.

[0087] In the above description of the abovementioned embodiment, the accelerator opening detection mechanism 70 including the holder 71, the sensor rotating shaft 72, the bearing 73, the sensor unit 74, the rotating member 75, the spacer 76, the return spring 77, the bracket 78, and the connector 79 is adopted as the accelerator opening detection mechanism. However, not limited to this, it is possible to adopt an accelerator opening detection mechanism having another configuration as long as the accelerator opening detection mechanism is attached to the throttle body 10 as being arranged at the same side of the throttle bores as the plurality of fuel injectors for detecting a rotation amount (accelerator opening) of the accelerator grip 4.

[0088] The abovementioned embodiment adopts a configuration that the throttle body 10 is divided into the first body 10A and the second body 10B. However, not limited to this, it is also possible to adopt the configuration of the present invention with an integrated throttle body.

INDUSTRIAL APPLICABILITY

[0089] As described above, the throttle device of the present invention can be easily arranged in a limited space for a multi-cylinder engine while achieving structural simplification, reduction in component count, component aggregation, device downsizing, and the like. Further, routing of an accelerator cable which connects an accelerator grip and an accelerator opening detection mechanism can be easily performed. Accordingly, the present invention is suitable for a throttle device for a multi-cylinder engine which is mounted on a motorcycle with a limited arrangement space and is useful for a vehicle having another engine as well.

EXPLANATION OF REFERENCES

[0090]

1	Multi-cylinder engine
2	Connection member
3	Intake system
4	Accelerator grip
5	Accelerator cable
5a	Outer cable
5b	Inner cable
M	Throttle device
10	Throttle body
10A	First body
10B	Second body
11	Throttle bore
S	Axis line
11a, 11b	Connection portion
12	Bearing hole
13	Mount portion
14	Boss portion
15	Case portion
16	Cover portion
17, 18	Connection portion
19	Mount portion
20	Throttle valve
30	Throttle shaft
L	Axis line
40	Drive mechanism
50	Fuel injector
51	Body portion

52	Connection portion
53	Connector
60	Delivery pipe
70	Accelerator opening detection mechanism
71	Holder
71a	Flange portion
71b	Bearing hole
71c	Fitting hole
71d	Cylinder portion
71e	Locking portion
71f	Flange portion
72	Sensor rotating shaft
L2	Axis line
72a	Large-diameter portion
72b	Small-diameter portion
72b'	Step
72c	Fixing portion
72c'	Washer
72c''	Nut
73	Bearing
73a	Inner ring
73b	Outer ring
73c	Rolling element
74	Sensor unit
75	Rotating member
75a	Fitting hole
75b	Drum portion
75c	Locking portion
75d	Abutting portion

76	Spacer
77	Return spring
77a	One end part
77b	Other end part
78	Bracket
78a	Fixing portion
78b	Stopper
79	Connector
80	Position sensor
B1, B2, B3, B4, B5, B6	Screw

Claims

1. A throttle device, comprising:

a throttle body which defines a plurality of throttle bores;
a plurality of throttle valves which open and close the plurality of throttle bores, respectively;
a throttle shaft which is supported by the throttle body to integrally rotate the plurality of throttle valves;
a drive mechanism which rotationally drives the throttle shaft;
a plurality of fuel injectors which are arranged as being laid out at one side section of the throttle body to inject fuel into the plurality of throttle bores; and
an accelerator opening detection mechanism which is arranged at the throttle body to detect opening of an accelerator grip via an accelerator cable,
wherein the accelerator opening detection mechanism is arranged on the same side as the one side section where the plurality of fuel injectors are laid out.

2. The throttle device according to claim 1,
wherein the accelerator opening detection mechanism is arranged between the plurality of fuel inj ectors in a laying-out direction of the throttle bores.

3. The throttle device according to claim 2, further comprising a delivery pipe which is arranged approximately in parallel with the throttle shaft to supply fuel to the plurality of fuel injectors,
wherein the accelerator opening detection mechanism is arranged between two injectors among the plurality of fuel injectors at an area which is not protruded outward from the delivery pipe in a direction of an axis line of the throttle bores.

4. Throttle device according to any one of claims 1 to 3,
wherein the accelerator opening detection mechanism includes a rotating member to which an accelerator cable moving with rotation of the accelerator grip is connected, a sensor rotating shaft to which the rotating member is fixed to be integrally rotated, a holder which rotatably supports the sensor rotating shaft and which is fixed to the throttle body in a detachably attachable manner, and a sensor unit which detects a rotation angle of the sensor rotating shaft as being arranged at the holder.

5. The throttle device according to claim 4,
wherein the sensor rotating shaft is rotatably supported by the holder via a bearing which includes an inner ring and an outer ring,
the sensor rotating shaft includes a small-diameter portion to define a step to which the inner ring is externally fitted and to which one end part of the inner ring is abutted in the axis line direction, and

the rotating member is externally fitted to the small-diameter portion and fixed to the sensor rotating shaft as sandwiching a spacer which is abutted to the other end part of the inner ring.

6. The throttle device according to claim 4 or claim 5,
wherein the accelerator opening detection mechanism includes a bracket which fixes an outer cable of an accelerator cable and which is fixed to the holder in a detachably attachable manner to adjust a routing direction of the accelerator cable.

7. The throttle device according to any one of claims 1 to 6,
wherein the plurality of fuel injectors includes connectors which provide electric connection,
the accelerator opening detection mechanism includes a connector which provides electric connection, and
the connectors of the fuel injectors and the connector of the accelerator opening detection mechanism are arranged to be oriented approximately in the direction.

Fig.1

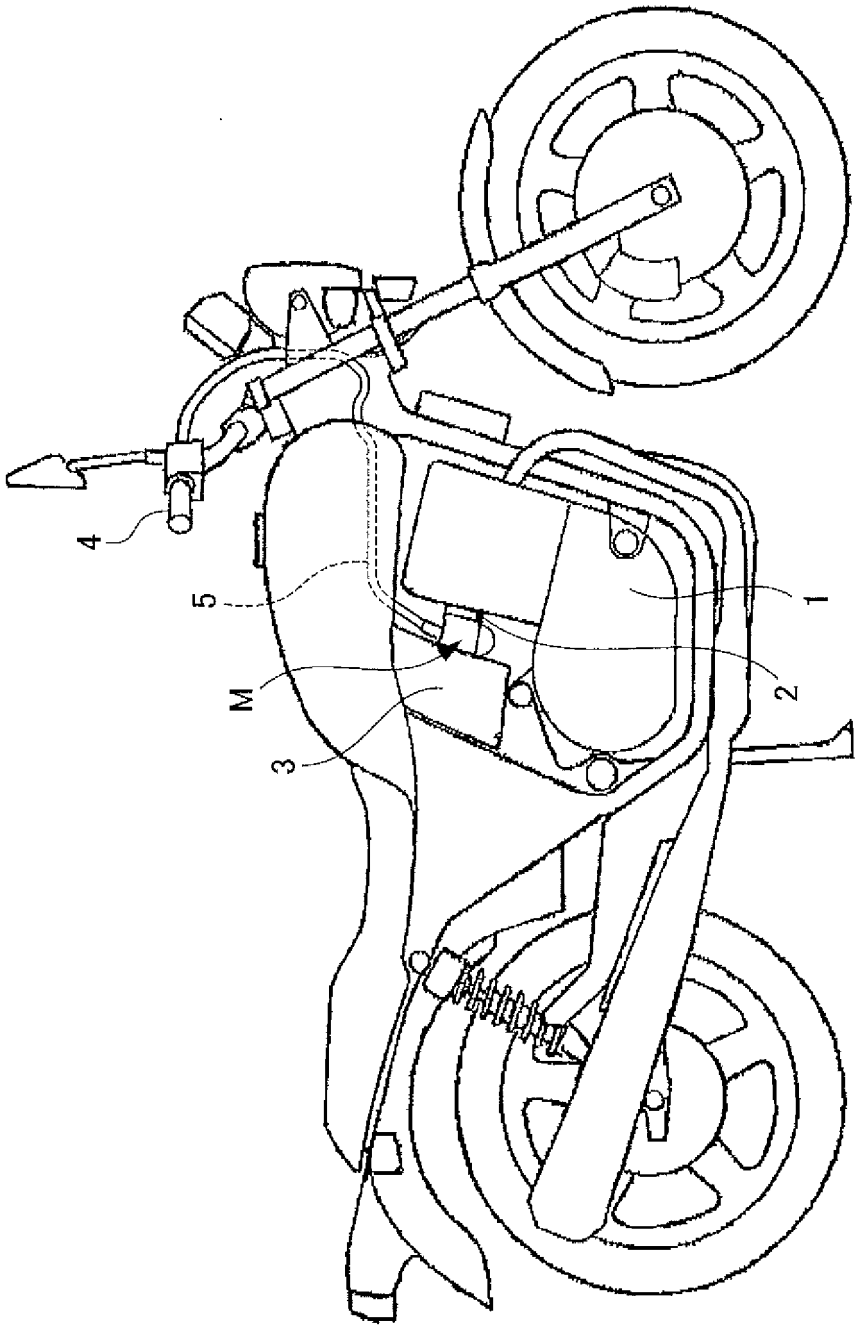
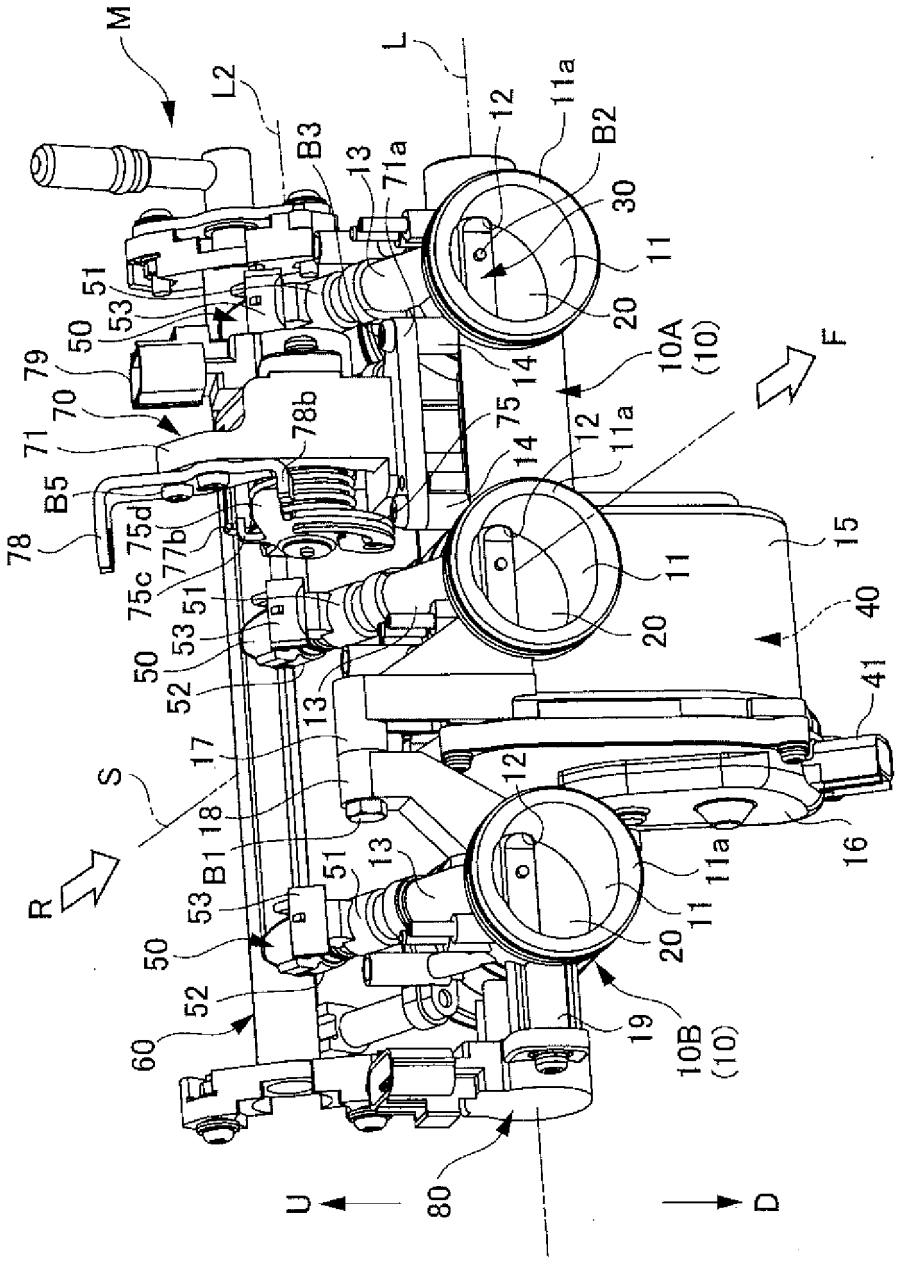


Fig.2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L2
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B3
13
71a
12
11a
B2
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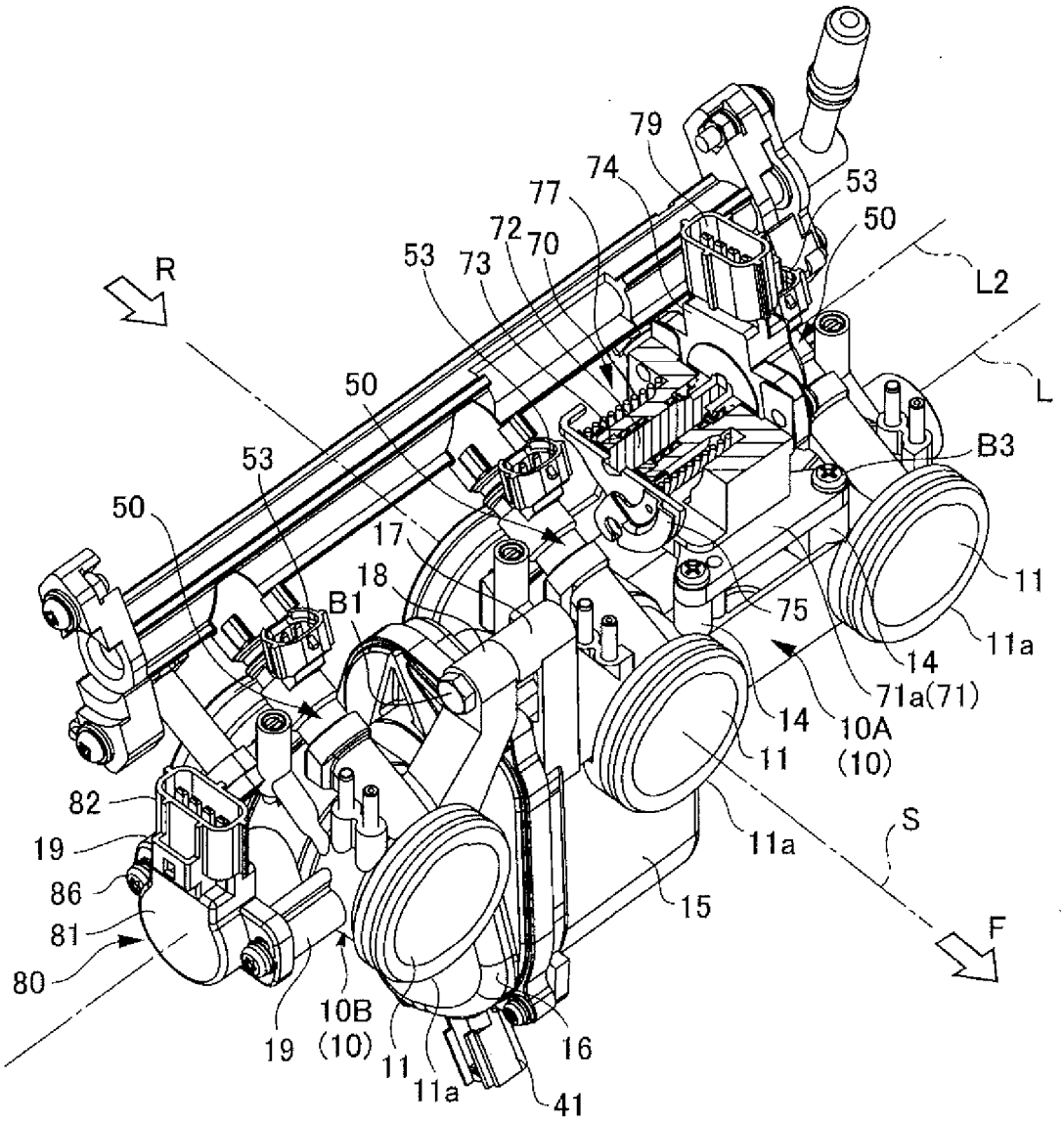
53
50
79
70
71
B5
78
75d
77b
75c
78b
14
75
10A
(10)
F
15
40
41
16
S
R
B1
17
18
52
60
19
10B
(10)
U
80
D

Fig.3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72
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73
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50
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B1
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11a
75
14
71a(71)
14
10A
(10)
11
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86
81
80
11a
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F
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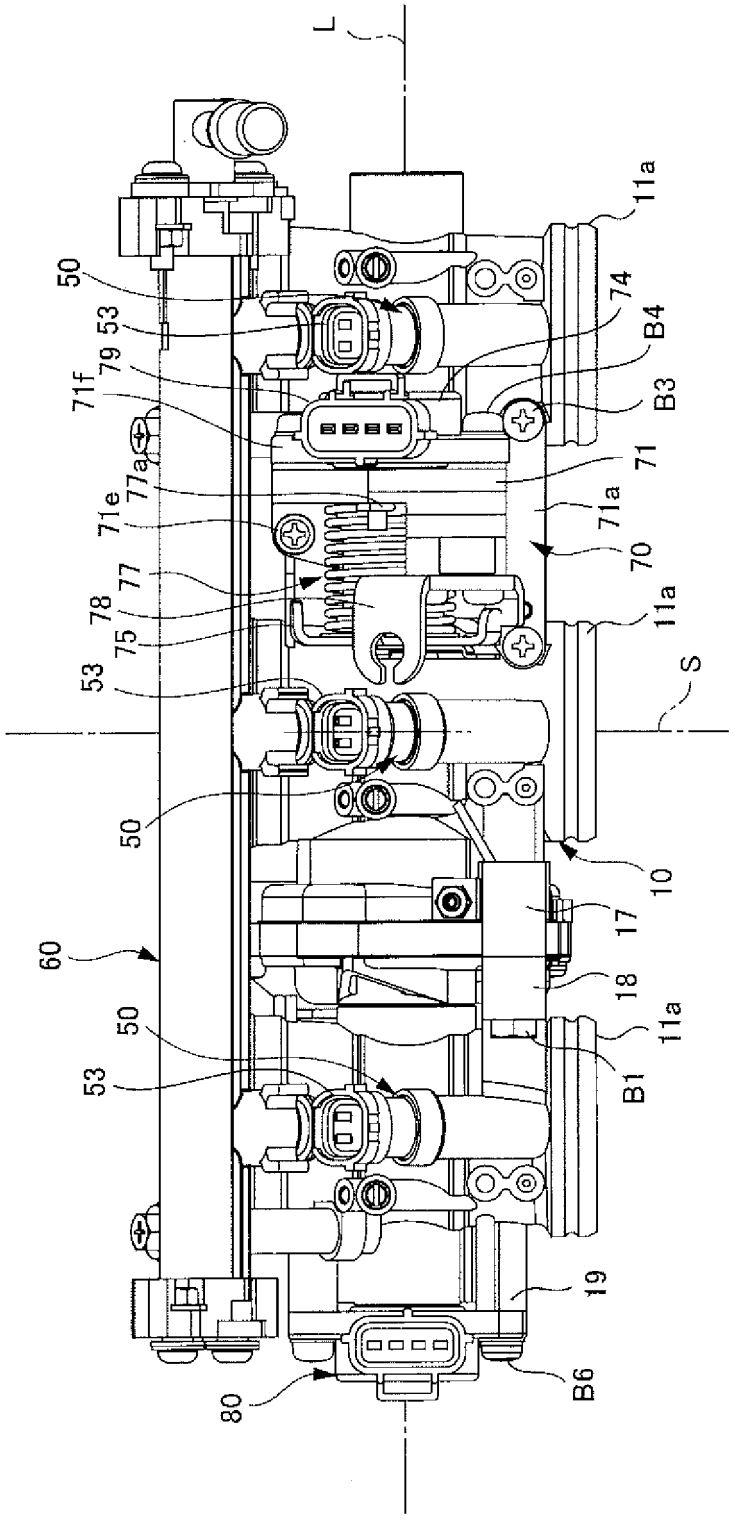
(10)
19
11
11a
16
41

Fig.4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B6
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Fig.5

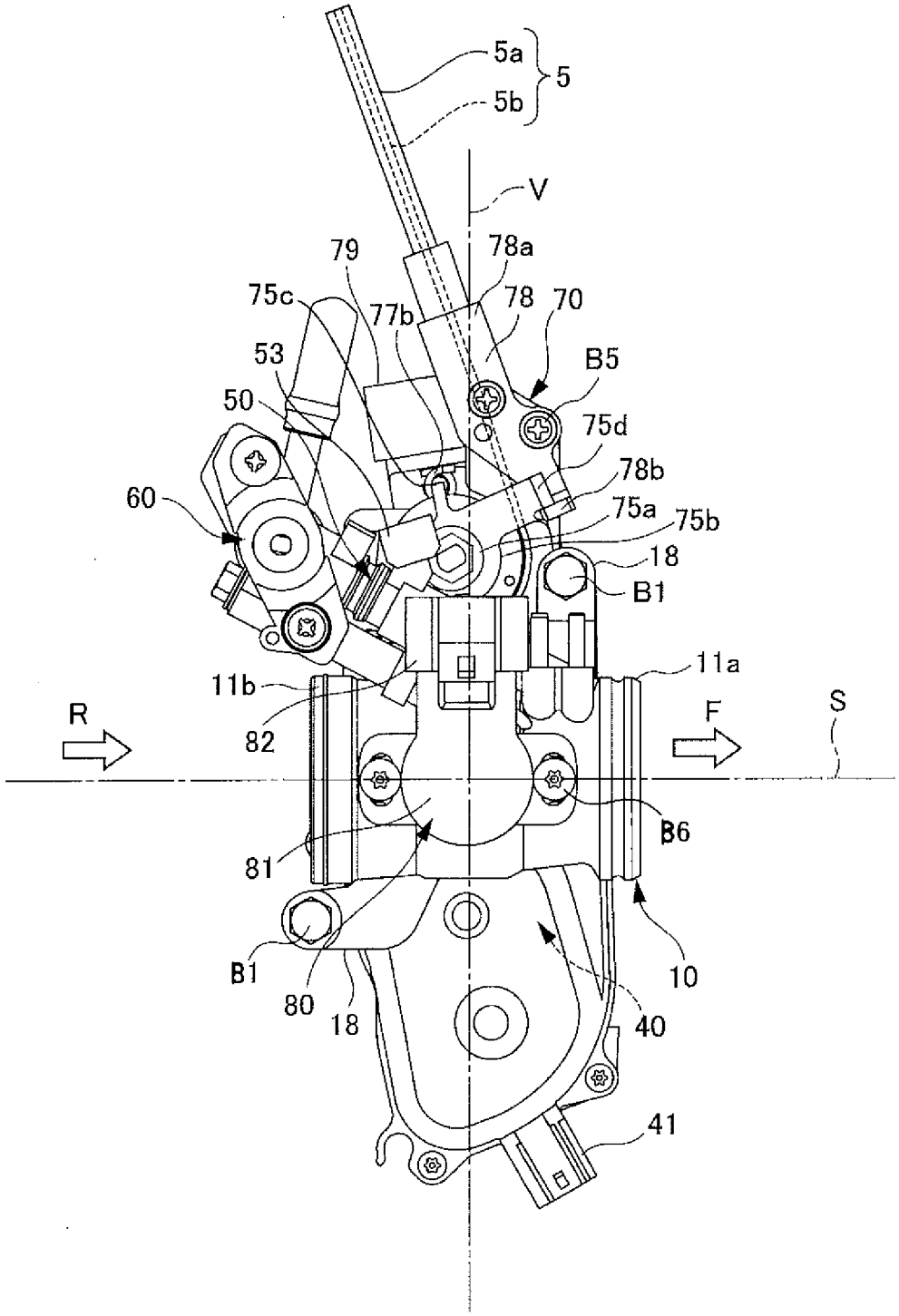
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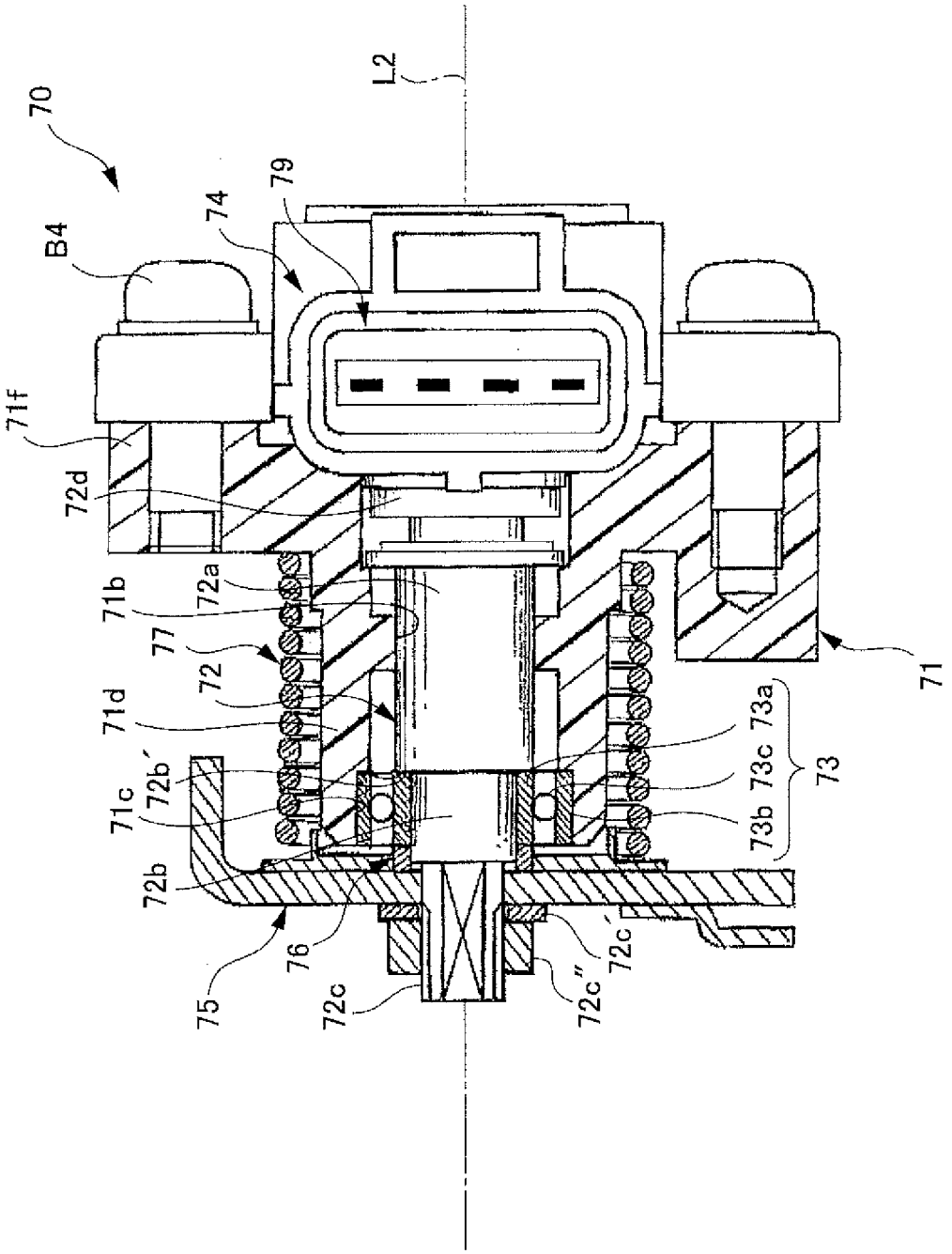
Fig.6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76
72c
72c''
72c'

Fig.7

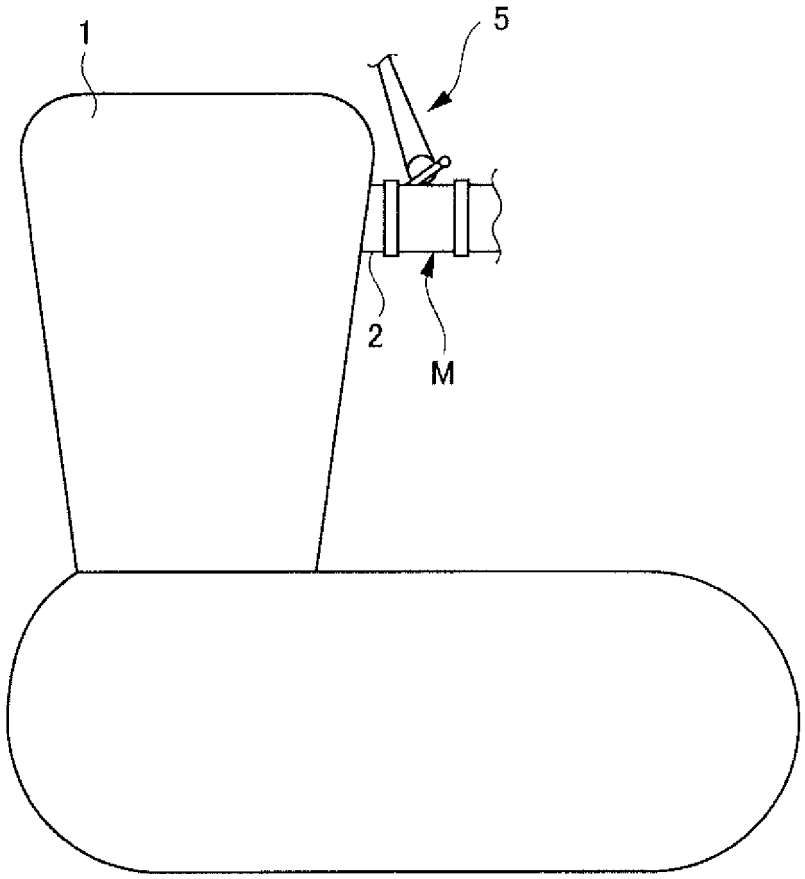
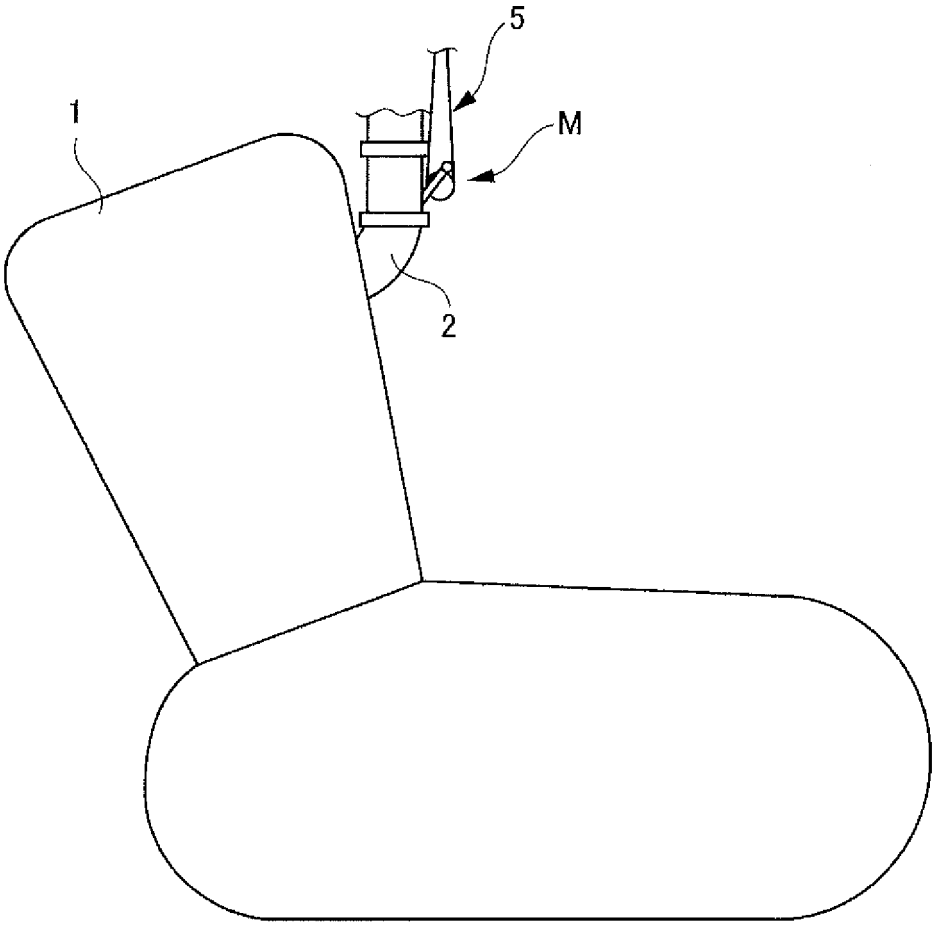


Fig.8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/068645

A. CLASSIFICATION OF SUBJECT MATTER
F02D9/02(2006.01)i, *F02D11/02*(2006.01)i, *F02D11/10*(2006.01)i

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)
F02D9/02, F02D11/02, F02D11/10

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-198355 A (Mikuni Corp.), 09 August 2007 (09.08.2007), entire text; all drawings (Family: none)	1-7
Y	JP 2010-52726 A (Yamaha Motor Co., Ltd.), 11 March 2010 (11.03.2010), paragraphs [0056], [0066] to [0084] & US 2010/0030436 A1 & EP 2149488 A2 & CN 101704366 A	1-7
Y	JP 2007-64096 A (Honda Motor Co., Ltd.), 15 March 2007 (15.03.2007), paragraphs [0024], [0027]; fig. 2, 4 (Family: none)	1-7

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

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Date of the actual completion of the international search 15 August, 2012 (15.08.12)	Date of mailing of the international search report 28 August, 2012 (28.08.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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