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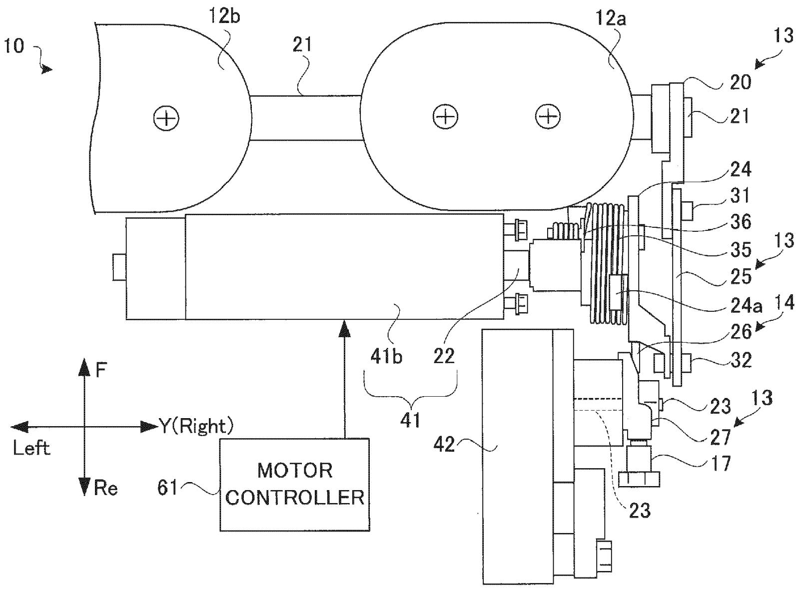
(54) THROTTLE DEVICE AND STRADDLED VEHICLE INCLUDING THE SAME

(57) There is discloseda small throttle device and a straddled vehicle including the same;. throttle device (10) including a throttle shaft (21), a drive motor (41) having a drive shaft (22) parallel with the throttle shaft (21), a rotary member (24) configured to rotate integrally with the drive shaft (22), a first transmission member configured to transmit rotational force of the rotary member (24) to the throttle shaft (21), a sensor shaft (23) parallel with the throttle shaft (21), a throttle position sensor (42) configured to detect a rotation angle of the sensor shaft (23), and a second transmission member configured to transmit the rotational force of the rotary member (24) to the sensor shaft (23); The throttle shaft (21), the drive shaft (22), and the sensor shaft (23) being disposed at positions parallel with one another, so that it is not necessary to dispose the throttle position sensor (42) on an extension of the throttle shaft (21), by which the throttle device (10) can be smaller in an extending direction of the throttle shaft (21).

Fig. 4



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Description

TECHNICAL FIELD

[0001] The present invention relates to a throttle device. The present invention relates to a straddled vehicle including the throttle device.

PRIOR ART

[0002] A throttle device described in JP 2013-104389 A includes a throttle body, a throttle shaft, a throttle valve, a drive motor, and a throttle position sensor. The throttle body has an intake passage. The throttle shaft is supported by the throttle body. The throttle valve is provided in the intake passage. The throttle valve is coupled to the throttle shaft. The drive motor is coupled to the throttle shaft. The drive motor is configured to rotate the throttle shaft. The throttle position sensor is installed at an end of the throttle shaft. The throttle position sensor is provided on an extension of the throttle shaft.

<List of Prior Art Documents>

[0003] JP 2013-104389 A

[0004] A conventional throttle device is relatively large. Specifically, the throttle device is long in an extending direction of the throttle shaft. Therefore, it is difficult to mount the throttle device on a straddled vehicle.

[0005] The present invention has been made in view of such circumstances, and an object of the present invention is to provide a small throttle device and a straddled vehicle including the throttle device.

DESCRIPTION OF THE INVENTION

[0006] In order to solve the above problem, the present invention has the following configurations.

[0007] That is, the present invention is a throttle device including a throttle body having an intake passage, a throttle shaft supported by the throttle body, a first throttle valve provided in the intake passage and coupled to the throttle shaft, a drive motor having a drive shaft parallel with the throttle shaft, a rotary member coupled to the drive shaft and configured to rotate integrally with the drive shaft, a first transmission member configured to transmit rotational force of the rotary member to the throttle shaft, a sensor shaft parallel with the throttle shaft, a throttle position sensor configured to detect a rotation angle of the sensor shaft, and a second transmission member configured to transmit the rotational force of the rotary member to the sensor shaft.

[0008] The throttle device includes the throttle body, the throttle shaft, and the first throttle valve. The throttle body has an intake passage. The throttle shaft is supported by the throttle body. The first throttle valve is provided in the intake passage. The first throttle valve is coupled to the throttle shaft. Therefore, the first throttle valve rotates integrally with the throttle shaft. When the throttle shaft rotates, the first throttle valve opens and closes the intake passages. The rotation angle of the throttle shaft corresponds to a position that the first throttle valve is in.

[0009] The throttle device includes the drive motor, the rotary member, the first transmission member, the sensor shaft, the second transmission member, and the throttle position sensor. The drive motor has the drive shaft. The rotary member is coupled to the drive shaft. The rotary member rotates integrally with the drive shaft. The first transmission member transmits rotational force of the rotary member to the throttle shaft. The second transmission member transmits the rotational force of the rotary member to the sensor shaft. The throttle position sensor detects a rotation angle of the sensor shaft. Therefore, when the drive shaft rotates, the throttle shaft and the sensor shaft rotate. Therefore, the throttle position sensor appropriately detects the position that the first throttle valve is in.

[0010] The sensor shaft is parallel with the throttle shaft. Therefore, the sensor shaft is not disposed on the extension of the throttle shaft. Therefore, the throttle position sensor is not disposed on the extension of the throttle shaft. Therefore, the throttle device is small in size. For example, the throttle device is short in the extending direction of the throttle shaft.

[0011] As described above, the drive motor rotates the throttle shaft via the first transmission member and rotates the sensor shaft via the second transmission member. That is, the throttle shaft and the sensor shaft are coupled in parallel with the drive motor. Therefore, flexibility of arrangement of the sensor shaft is high.

[0012] In the throttle device described above, the rotational force of the rotary member is preferably transmitted to the sensor shaft not via the first transmission member.

[0013] According to such a configuration, flexibility of arrangement of the sensor shaft is high.

[0014] In the throttle device described above, the first transmission member preferably includes a first lever rotatably coupled to the rotary member, and a first arm rotatably coupled to the first lever, and the first arm is preferably coupled to the throttle shaft.

[0015] According to such a configuration, it is easy for the first transmission member to transmit the rotational force of the rotary member to the throttle shaft.

[0016] In the throttle device described above, the second transmission member preferably includes a second lever rotatably coupled to the rotary member, and a second arm rotatably coupled to the second lever, and the second arm is preferably coupled to the sensor shaft.

[0017] According to such a configuration, it is easy for the first transmission member to transmit the rotational force of the rotary member to the sensor shaft.

[0018] In the throttle device described above, a distance between the sensor shaft and the throttle shaft is preferably equal to or longer than a distance between the drive shaft and the throttle shaft, and the distance between the sensor shaft and the throttle shaft is preferably equal to or longer than a distance between the drive shaft and the sensor shaft.

[0019] The distance between the sensor shaft and the throttle shaft is equal to or longer than a distance between the drive shaft and the throttle shaft. Therefore, the distance between the drive shaft and the throttle shaft is relatively short. Therefore, it is easy to reduce a size of the first transmission member. The distance between the sensor shaft and the throttle shaft is equal to or longer than the distance between the drive shaft and the throttle shaft. Therefore, the distance between the drive shaft and the sensor shaft is relatively short. Therefore, it is easy to reduce a size of the second transmission member. The distance between the sensor shaft and the throttle shaft is relatively long. Therefore, it is easy to prevent interference between the first transmission member and the second transmission member.

[0020] In the throttle device described above, at least a portion of the throttle position sensor is preferably at the same position as the drive shaft in an extending direction of the drive shaft.

[0021] According to such a configuration, the throttle position sensor and the drive shaft can overlap each other in the extending direction of the drive shaft. Therefore, the throttle device is even smaller in size. For example, the throttle device is even short in the extending direction of the throttle shaft.

[0022] In the throttle device described above, at least a portion of the drive shaft is preferably at the same position as the first throttle valve in an extending direction of the drive shaft, and at least a portion of the throttle position sensor is preferably at the same position as the first throttle valve in the extending direction of the drive shaft.

[0023] According to the above-described configuration, the first throttle valve and the drive shaft can overlap each other in the extending direction of the drive shaft. The first throttle valve and the throttle position sensor can overlap each other in the extending direction of the drive shaft. Therefore, a size of the throttle device in the extending direction of the throttle shaft is further reduced. The drive shaft and the throttle position sensor are disposed near the first throttle valve. That is, the drive shaft and the throttle position sensor are close to each other. Therefore, it is easy to reduce the size of the second transmission member.

[0024] The throttle device described above preferably further includes a second throttle valve provided in the intake passage and coupled to the throttle valve, in which the first throttle valve is preferably disposed between the first transmission member and the second throttle valve along with the throttle shaft, the drive shaft is preferably disposed between the first transmission member and the second throttle valve in an extending direction of the throttle shaft, and the throttle position sensor is preferably disposed between the first transmission member and the second throttle valve in the extending direction of the throttle shaft.

[0025] According to such a configuration, the drive shaft and the throttle position sensor are disposed near the first throttle valve. Therefore, the drive shaft and the throttle position sensor are close to each other. Therefore, it is easy to reduce the size of the second transmission member. According to such a configuration, the throttle device includes two throttle valves, and the drive shaft and the throttle position sensor are disposed to be biased to the first throttle valve. With this configuration, a size of a mechanism mechanically connecting the drive shaft and the throttle position sensor can be reduced.

[0026] In the throttle device described above, the second transmission member is preferably provided between the first transmission member and the drive motor in an extending direction of the drive shaft.

[0027] According to such a configuration, it is easy to shorten the throttle device in the extending direction of the throttle shaft.

[0028] In the throttle device described above, the sensor shaft preferably rotates in a first direction when a first throttle valve rotates in a closing direction, and the throttle device preferably further includes a first stopper mechanism that forbids the first throttle valve from further rotating in the closing direction when the first throttle valve is in a fully closed position, and

a second stopper mechanism that forbids the sensor shaft from further rotating in the first direction when the first throttle valve is in the fully closed position.

[0029] The throttle device includes the first stopper mechanism and the second stopper mechanism. The first stopper mechanism forbids the first throttle valve from further rotating in the closing direction when the first throttle valve is in the fully closed position. The second stopper mechanism forbids the sensor shaft from further rotating in the first direction when the first throttle valve is in the fully closed position. Therefore, in a state where the first throttle valve is stationary in the fully closed position, the sensor shaft is also stationary. In a state where the first throttle valve is stationary in the fully closed position, the rotation angle of the sensor shaft does not change. Therefore, the position that the first throttle valve is in is accurately reflected in the rotation angle of the sensor shaft. Therefore, the throttle position sensor appropriately detects the position that the first throttle valve is in.

[0030] In the throttle device described above, the sensor shaft preferably rotates in a second direction when the first throttle valve rotates in an opening direction, and when the first throttle valve shifts in the opening direction from the fully closed position, a timing at which the sensor shaft starts to rotate in the second direction preferably coincides with a timing at which the first throttle valve starts to rotate in the opening direction.

[0031] According to such a configuration, a timing at which the first throttle valve in the fully closed state starts to open coincides with a timing at which the sensor shaft starts to rotate. Therefore, even when the first throttle valve shifts in the opening direction from the fully closed position, the position the first throttle valve is in is accurately reflected in the rotation angle of the sensor shaft. Therefore, even when the first throttle valve shifts in the opening direction from the fully closed position, the throttle position sensor accurately detects the position that the first throttle valve is in.

[0032] In the throttle device described above, a timing at which the second stopper mechanism stops rotation of the sensor shaft in the first direction preferably coincides with a timing at which the first stopper mechanism stops rotation of the first throttle valve in the closing direction.

[0033] According to such a configuration, a timing at which the first throttle valve enters the fully closed state coincides with a timing at which the sensor shaft stops rotating. Therefore, when the first throttle valve shifts in the opening direction from the fully closed position, it is easy to match the timing at which the sensor shaft starts to rotate in the second direction and the timing at which the first throttle valve starts to rotate in the opening direction.

[0034] In the throttle device described above, the first stopper mechanism preferably includes a first limiter coupled to the throttle body, and a first rotation contact part coupled to the throttle shaft, and when the first throttle valve is in the fully closed position, the first rotation contact part is preferably in contact with the first limiter, and the first limiter preferably forbids the first throttle valve from further rotating in the closing direction, and the second stopper mechanism preferably includes a second limiter coupled to the throttle body, and a second rotation contact part coupled to the sensor shaft, and when the second throttle valve is in the fully closed position, the second rotation contact part is preferably in contact with the second limiter, and the second limiter preferably forbids the sensor shaft from further rotating in the first direction.

[0035] The first stopper mechanism includes the first limiter and the first rotation contact part. Therefore, it is easy for the first stopper mechanism to forbid the first throttle valve from further rotating in the closing direction when the first throttle valve is in the fully closed position. The second stopper mechanism includes the second limiter and the second rotation contact part. Therefore, it is easy for the second stopper mechanism to forbid the sensor shaft from further rotating in the first direction when the first throttle valve is in the fully closed position.

[0036] In the throttle device described above, the second limiter preferably includes an adjustment screw supported by the throttle body.

[0037] The second limiter includes the adjustment screw. Therefore, the adjustment screw finely adjusts a timing at which the second rotation contact part comes into contact with the second limiter. The adjustment screw finely adjusts a timing at which the second limiter forbids the sensor shaft from further rotating in the first direction.

[0038] The present invention is a straddled vehicle including the above-described throttle device. The throttle device is small in size. Therefore, it is easy to mount the throttle device on the straddled vehicle.

[0039] The throttle device of the present invention is compact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040]

[FIG. 1] A plan view for describing an overall configuration of a two-wheel motor vehicle according to an embodiment.

[FIG. 2] A perspective view for describing a throttle device according to the embodiment.

[FIG. 3] A plan view for describing a throttle body according to the embodiment.

[FIG. 4] A plan view for describing a positional relationship among respective shafts according to the embodiment.

[FIG. 5] A perspective view for describing a return spring according to the embodiment.

[FIG. 6] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 7] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 8] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 9] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 10] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 11] A right side view for describing operation of the throttle device according to the embodiment.

[FIG. 12] A plan view for describing one modification of the present invention.

[0041] A detailed description will hereinafter be given of an embodiment of the present invention with consultation of drawings. A vehicle of the embodiment is a straddled vehicle including an internal combustion engine. The vehicle according to the embodiment includes a throttle device. The throttle device adjusts an amount of intake air supplied to the internal combustion engine. The throttle device includes butterfly-type throttle valves, a mechanism for rotating the throttle valves, and a mechanism for detecting an opening degree of the throttle valves.

1. Overall configuration

[0042] FIG. 1 shows an overall configuration of a two-wheel motor vehicle 1 of the present invention. The two-wheel motor vehicle 1 is an example of a straddled vehicle. As shown in FIG. 1, the two-wheel motor vehicle 1 according to the embodiment includes a vehicle body frame 51, a front wheel 3 and rear wheel 4, an internal combustion engine (engine) 5 having a two-cylinder configuration, an exterior cover, and a seat 53. The two-wheel motor vehicle 1 according to the embodiment includes a front fork 6 that supports the front wheel 3 and a handlebar 54 for rotating the front fork 6. To ride on the two-wheel motor vehicle 1, a driver sits on the seat 53 while gripping the handlebar 54 and straddles the two-wheel motor vehicle 1. When the driver operates an accelerator in this state, the throttle device is operated accordingly, and the amount of intake air supplied to the internal combustion engine 5 is adjusted.

[0043] Note that the reference sign F in FIG. 1 denotes forward of the vehicle, and the reference sign Re denotes rearward of the vehicle. In FIG. 1, the reference sign U denotes an upward direction, and reference sign D denotes a downward direction. A width direction Y is a direction orthogonal to a front-rear direction and an up-down direction. The front-rear direction, the up-down direction, and the width direction Y are defined with reference to the driver riding on the two-wheel motor vehicle 1. In the following drawings as well, these reference signs are appropriately denoted in order to clarify a direction of each member installed in the two-wheel motor vehicle 1.

2. Throttle device

[0044] FIG. 2 is a perspective view showing a configuration of a throttle device 10 according to the embodiment. The throttle device 10 is directly or indirectly connected to the internal combustion engine 5. As shown in FIG. 2, the throttle device 10 of the present example includes a throttle body 11 having intake passages V The intake passages V are configured to send air to the internal combustion engine 5, and the two intake passages V are provided in the throttle body 11. The throttle device 10 includes the throttle body 11 equipped with movable members, a sensor, members related to positioning of an adjustment screw or the like. The throttle body 11 supports a throttle shaft 21 described later.

[0045] Refer to FIG. 3. A first throttle valve 12a is provided in an intake passage V and is coupled to the throttle shaft 21. Similarly, a second throttle valve 12b is provided in an intake passage V and is coupled to the throttle shaft 21. That is, as shown in FIG. 3, butterfly-type throttle valves are provided in the respective intake passages V. The first throttle valve 12a and second throttle valve 12b are arranged in the width direction Y. The two throttle valves 12a and 12b are fixed to the throttle shaft 21 extending in the width direction Y, and configured to tilt along with rotation of the throttle shaft 21. The first throttle valve 12a and second throttle valve 12b rotate integrally with the throttle shaft 21 and tilt to adjust an amount of air passing through the intake passages V.

[0046] When the throttle shaft 21 is at an initial angle, the first throttle valve 12a and second throttle valve 12b are in a fully closed position. When the first throttle valve 12a and second throttle valve 12b are in the fully closed position, the intake passages V are in a state where it is most difficult for air to pass therethrough. When the throttle shaft 21 is rotated from the initial angle, the first throttle valve 12a and second throttle valve 12b rotate in an opening direction. When the first throttle valve 12a and second throttle valve 12b rotate in the opening direction, a tilt angle of the first throttle valve 12a and second throttle valve 12b approaches 90°. Eventually, the first throttle valve 12a and second throttle valve 12b reach a fully open position. When the first throttle valve 12a and second throttle valve 12b are in the fully open position, the intake passages V are in a state where it is easiest for air to pass therethrough.

[0047] As shown in FIG. 4, a drive motor 41 has a drive shaft 22 parallel with the throttle shaft 21. The drive shaft 22 is also referred to as a motor shaft. The drive motor 41 is configured to rotate the throttle shaft 21. The drive shaft 22 is a shaft through which the drive motor 41 outputs rotational force.

[0048] As shown in FIG. 4, the drive motor 41 has a main body 41b that rotates the drive shaft 22. The main body 41b has a cylindrical shape extending in the width direction Y. The drive shaft 22 protrudes in the width direction Y from the main body 41b. For example, the drive shaft 22 extends rightward from the main body 41b. In the main body 41b, electromagnetic coils and permanent magnets are concentrically arranged. The rotational force of the drive motor 41 is transmitted to the throttle shaft 21 by a first transmission member 13. Details of the first transmission member 13 will be described later.

[0049] A sensor shaft 23 is parallel with the throttle shaft 21 and the drive shaft 22. When the drive shaft 22 of the present embodiment starts to rotate, the throttle shaft 21 starts to rotate on the basis of the first transmission member 13, and the sensor shaft 23 starts to rotate on the basis of a second transmission member 14.

[0050] The throttle position sensor 42 is configured to detect a rotation angle of the sensor shaft 23. As shown in FIG. 4, the throttle position sensor 42 is provided at a position close to one end of the drive motor 41. The throttle position sensor 42 is provided at a position close to the drive shaft 22. For example, the throttle position sensor 42 is provided to the right of the drive motor 41. More specifically, a left end of the throttle position sensor 42 is to the left of a right end of the main body 41b of the drive motor. A right end of the throttle position sensor 42 is to the right of the right end of the main body 41b of the drive motor. This configuration reduces length of the throttle device 10 in an axial direction Y. For example, the throttle device 10 in this configuration is smaller in dimension in the width direction Y than when in a configuration in which the drive motor 41 and the throttle position sensor 42 are arranged in a row in the width direction Y. Therefore, it is easy to mount the throttle device 10 on the two-wheel motor vehicle 1.

[0051] The drive motor 41 is provided on a right end portion of the throttle body 11. The throttle position sensor 42 is also provided on the right end portion of the throttle body 11.

[0052] As can be seen with reference to FIG. 4, at least a portion of the throttle position sensor 42 is at the same position as the drive shaft 22 in an extending direction (width direction Y) of the drive shaft 22. Specifically, the throttle position sensor 42 has the left end positioned to the left of a right end of the drive shaft 22 and the right end positioned to the right of a left end of the drive shaft 22.

[0053] At least a portion of the throttle position sensor 42 is at the same position as the drive motor 41. Specifically, the left end of the throttle position sensor 42 is positioned to the left of a right end of the drive motor 41, and the right end of the throttle position sensor 42 is positioned to the right of a left end of the drive motor 41.

[0054] The throttle position sensor 42 is a sensor attached to the throttle device 10, and has a function of detecting rotation of a shaft by using this. That is, a through hole through which a main shaft passes is provided in a housing of the throttle position sensor 42, and the main shaft passes through the through hole and extends rightward (in the width direction Y) from an inside of the throttle position sensor 42. The main shaft is a part included in the throttle position sensor 42, and is combined to the sensor shaft 23 extending on an extension of the main shaft when attached to the throttle device 10.

[0055] The main shaft and the sensor shaft 23 are firmly integrated via a spring. Between the main shaft and the sensor shaft 23, there is a clearance necessary for fastening the throttle position sensor 42 to the throttle body 11. Because the clearance is invalidated by biasing force of the spring, there is no backlash between the sensor shaft 23 and the main shaft. The rotational force of the drive motor 41 is transmitted to the sensor shaft 23 by the second transmission member 14. Details of the second transmission member 14 will be described later.

[0056] As described above, the sensor shaft 23 of the throttle device 10 of the present example is not provided on an extension of the throttle shaft 21 and is not coaxial with the throttle shaft 21. The sensor shaft 23 is disposed at a position different from a position of the throttle shaft 21, and specifically, the sensor shaft 23 is disposed so as to be parallel with the throttle shaft 21. Similarly, the sensor shaft 23 of the throttle device 10 of the present example is not provided on an extension of the drive shaft 22 and is not coaxial with the drive shaft 22. The sensor shaft 23 is disposed at a position different from a position of the drive shaft 22, and specifically, the sensor shaft 23 is disposed so as to be parallel with the drive shaft 22.

[0057] As can be seen with reference to FIG. 4, at least a portion of the drive shaft 22 is at the same position as the throttle shaft 21 in an extending direction (width direction Y) of the throttle shaft 21. For example, the entire drive shaft 22 is positioned to the left of a right end of the throttle shaft 21 and to the right of a left end of the throttle shaft 21. That is, the drive shaft 22 falls within a section extending in the axial direction Y, the section being defined by positions of the both ends of the throttle shaft 21. The drive shaft 22 is shorter in length than the throttle shaft 21. Therefore, a compact throttle device 10 can be provided.

[0058] At least a portion of the sensor shaft 23 is at the same position as the throttle shaft 21 in the extending direction (width direction Y) of the drive shaft 22. For example, the entire sensor shaft 23 is positioned to the left of the right end of the throttle shaft 21 and to the right of a left end of the throttle shaft 21.

[0059] The drive shaft 22 is disposed to the left of the sensor shaft 23 in an extending direction (width direction Y) of the sensor shaft 23. However, the present invention is not limited thereto. At least a portion of the drive shaft 22 may be disposed at the same position as the sensor shaft 23 in the extending direction (width direction Y) of the sensor shaft 23. For example, the left end of the drive shaft 22 may be to the left of a right end of the sensor shaft 23, and the right end of the drive shaft 22 may be to the right of a left end of the sensor shaft 23.

[0060] As can be seen with reference to FIG. 4, at least a portion of the drive shaft 22 is at the same position as the first throttle valve 12a in the extending direction (width direction Y) of the drive shaft 22. Specifically, at least a portion of the drive shaft 22 is positioned to the left of a right end of the first throttle valve 12a and to the right of a left end of the first throttle valve 12a.

[0061] At least a portion of the throttle position sensor 42 is at the same position as the first throttle valve 12a in the extending direction (width direction Y) of the drive shaft 22. Specifically, at least a portion of the throttle position sensor 42 is positioned to the left of a right end of the first throttle valve 12a and to the right of a left end of the first throttle valve 12a.

[0062] FIG. 6 is a right side view of the throttle device 10. Separation distances of each shaft will be described with reference to FIG. 6. As can be seen with reference to the drawing, a distance between the sensor shaft 23 and the throttle shaft 21 is equal to or longer than a distance between the drive shaft 22 and the throttle shaft 21. The distance between the sensor shaft 23 and the throttle shaft 21 is equal to or longer than a distance between the drive shaft 22 and the sensor shaft 23. That is, the distance between the throttle shaft 21 and the sensor shaft 23 is equal to or longer than other distances, that is, the distance between the throttle shaft 21 and the drive shaft 22 and the distance between the sensor shaft 23 and the drive shaft 22. For example, the drive shaft 22 may be disposed at an intermediate position between the throttle shaft 21 and the sensor shaft 23 in a direction connecting the throttle shaft 21 and the sensor shaft 23. As a result, the throttle device 10 has a compact configuration. For example, the first transmission member 13 is compact. For example, the second transmission member 14 is compact.

3. Transmission members

[0063] Hereinafter, the transmission members that transmit the rotational force of the drive motor 41 will be described. As shown in FIG. 2, the throttle device 10 of the present example includes a rotary member 24 having a circular shape. The rotary member 24 is coupled to the drive shaft 22 and rotates integrally with the drive shaft

22. The throttle device 10 includes the first transmission member 13 and the second transmission member 14. The first transmission member 13 and the second transmission member 14 are connected to the rotary member 24.

[0064] The first transmission member 13 transmits rotational force of the rotary member 24 to the throttle shaft 21. Specifically, the first transmission member 13 includes a first lever 25 and a first arm 20. The first lever 25 is rotatably coupled to the rotary member 24. Meanwhile, the first arm 20 is a member extending in a direction orthogonal to the throttle shaft 21, and is rotatably coupled to the first lever 25. The first arm 20 is coupled to the throttle shaft 21. Therefore, the first lever 25 is a member that transmits rotational force of the rotary member 24 to the first arm 20.

[0065] The first lever 25 extends in a direction orthogonal to the drive shaft 22. One end of the first lever 25 is disposed on the rotary member 24, and another end of the first lever 25 is disposed on the first arm 20. The rotary member 24, the first lever 25, and the first arm 20 constitute a link mechanism. The first lever 25 is configured to rotate the first arm 20 by receiving the rotational force of the rotary member 24.

[0066] The first lever 25 is coupled to the rotary member 24 via a joint 32. The joint 32 couples the first lever 25 to the rotary member 24. Specifically, the rotary member 24 has a first protrusion extending in a direction away from the drive shaft 22. The one end of the first lever 25 is fastened to the first protrusion of the rotary member 24 via the joint 32. The one end of the first lever 25 is rotatable with respect to the first protrusion. The first lever 25 is rotatable around the joint 32 with respect to the rotary member 24. The rotary shaft of the joint 32 is parallel with the drive shaft 22. The joint 32 is provided at a position away from a rotation center of the drive shaft 22.

[0067] The joint 32 is a concavo-convex joint. The rotary member 24 has a first projection provided on the first protrusion of the rotary member 24. The first lever 25 has a first through hole provided on the one end of the first lever 25. The first projection of the rotary member 24 is fitted into the first through hole of the first lever 25. The first projection protrudes in a direction (width direction Y) in which the drive shaft 22 extends, and the first through hole penetrates the first lever 25 in the direction (width direction Y) in which the drive shaft 22 extends. The joint 32 includes a bearing. The bearing is provided between the first projection of the rotary member 24 and the first through hole of the first lever 25.

[0068] The joint 32 has backlash. The joint 32 has a degree of clearance between parts. For example, the joint 32 has a degree of clearance between the first projection of the rotary member 24 and the first through hole of the first lever 25. This is because it is necessary to allow a degree of clearance between the parts in order for the joint 32 to operate smoothly.

[0069] The first lever 25 is coupled to the first arm 20 via a joint 31. The joint 31 couples the first lever 25 to the first arm 20. Specifically, the another end of the first lever 25 is fastened to one end of the first arm 20 via the joint 31. The another end of the first lever 25 is rotatable with respect to the one end of the first arm 20. The first lever 25 is rotatable around the joint 31 with respect to the first arm 20. The rotary shaft of the joint 31 is parallel with the drive shaft 22. The joint 31 is provided at a position away from a rotation center of the throttle shaft 21.

[0070] The joint 31 is a concavo-convex joint. The first arm 20 has a projection provided at the one end of the first arm 20. The first lever 25 has a second through hole provided on the another end of the first lever 25. The projection of the first arm 20 is fitted into the second through hole of the first lever 25. The projection of the first arm 20 protrudes in a direction (width direction Y) in which the throttle shaft 21 extends, and the second through hole penetrates the first lever 25 in the direction (width direction Y) in which the drive shaft 22 extends. In the present embodiment, the joint 31 includes a bearing. The bearing is provided between the projection of the first arm 20 and the second through hole of the first lever 25.

[0071] The joint 31 has backlash. The joint 31 has a degree of clearance between parts. For example, the joint 31 has a degree of clearance between the projection of the first arm 20 and the second through hole of the first lever 25. This is because it is necessary to allow a degree of clearance between parts in order for the joint 31 to operate smoothly.

[0072] The second transmission member 14 transmits the rotational force of the rotary member 24 to the sensor shaft 23. The rotational force of the rotary member 24 is transmitted to the sensor shaft 23 not via the first transmission member 13. That is, although both the first transmission member 13 and the second transmission member 14 operate by obtaining rotational force from the rotary member 24, the transmission members are mechanisms of different systems. The second transmission member 14 has a configuration different from a configuration of the first transmission member 13, and transmits the rotational force of the rotary member 24 to the sensor shaft 23.

[0073] Specifically, the second transmission member 14 includes a second lever 26 and a second arm 27. The second lever 26 is rotatably coupled to the rotary member 24. Meanwhile, the second arm 27 is a member extending in a direction orthogonal to the sensor shaft 23, and is rotatably coupled to the second lever 26. The second arm 27 is coupled to the sensor shaft 23. Therefore, the second lever 26 is a member that transmits rotational force of the rotary member 24 to the second arm 27. The second lever 26 extends in a direction orthogonal to the sensor shaft 23. One end of the second lever 26 is disposed on the rotary member 24, and another end of the second lever 26 is disposed on the second arm 27. The rotary member 24, the second lever 26, and the second arm 27 constitute a link mechanism. The second lever 26 is configured to rotate the second arm 27 by receiving the rotational force of the rotary member 24.

[0074] The second lever 26 is coupled to the rotary member 24 via a joint 33. The joint 33 couples the second lever 26 to the rotary member 24. Specifically, the rotary member 24 has a second protrusion extending in a direction away from the drive shaft 22. The one end of the second lever 26 is fastened to the second protrusion of the rotary member 24 via the joint 33. The one end of the second lever 26 is rotatable with respect to the second protrusion. The second lever 26 is rotatable around the joint 33 with respect to the rotary member 24. The rotary shaft of the joint 33 is parallel with the drive shaft 22.

[0075] The second lever 26 is coupled to the second arm 27 via a joint 34. The joint 34 couples the second lever 26 to the second arm 27. Specifically, the another end of the second lever 26 is fastened to one end of the second arm 27 via the joint 34. The another end of the second lever 26 is rotatable with respect to the one end of the second arm 27. The second lever 26 is rotatable around the joint 34 with respect to the second arm 27. The rotary shaft of the joint 34 is parallel with the drive shaft 22.

[0076] Refer to FIG. 2. The first transmission member 13 is provided on the right end portion of the throttle body 11. The second transmission member 14 is provided on the right end portion of the throttle body 11.

[0077] Refer to FIG. 4. The first transmission member 13 is coupled to one end of the throttle shaft 21. For example, the first transmission member 13 is coupled to the right end of the throttle shaft 21.

[0078] The first throttle valve 12a is positioned between the first transmission member 13 and the second throttle valve 12b along the throttle shaft 21. For example, the first throttle valve 12a is disposed on the left of the first transmission member 13 and on the right of the second throttle valve 12b.

[0079] The drive shaft 22 is positioned between the first transmission member 13 and the second throttle valve 12b in the extending direction (width direction Y) of the throttle shaft 21. For example, the drive shaft 22 is positioned to the left of the first transmission member 13 and to the right of the second throttle valve 12b.

[0080] The throttle position sensor 42 is positioned between the first transmission member 13 and the second throttle valve 12b in the extending direction (width direction Y) of the throttle shaft 21. For example, the throttle position sensor 42 is positioned to the left of the first transmission member 13 and to the right of the second throttle valve 12b.

[0081] The entire second transmission member 14 is disposed to the left of the right end of the throttle shaft 21. The entire second transmission member 14 is disposed to the right of the left end of the throttle shaft 21.

[0082] The second transmission member 14 is provided between the first transmission member 13 and the drive motor 41 in the extending direction (width direction Y) of the drive shaft 22. For example, the second transmission member 14 is disposed to the left of the first transmission member 13 and to the right of the drive motor 41. Therefore, the first lever 25 and the second lever 26 are in different positions in the width direction Y so as not to interfere with each other (refer to FIGS. 2 and 4). For example, the first lever 25 is positioned to the right of the second lever 26. In other words, with respect to a right end portion of the throttle device 10, the second lever 26 is positioned on a back side of the first lever 25.

[0083] As described above, the second transmission member 14 is provided between the first transmission member 13 and the drive motor 41 in the extending direction (width direction Y) of the drive shaft 22. Therefore, the right end of the throttle shaft 21 interlocked with the first lever 25 can be disposed on the right end portion of the throttle device 10 as much as possible. It is easy to dispose the second transmission member 14 to the left of the right end of the throttle body 11 and to the right of a left end of the throttle body 11. For example, it is easy to suppress the second transmission member 14 from protruding rightward from the throttle body 11. Therefore, it is easy to reduce a dimension of the throttle device 10 in the width direction Y. For example, the dimension of the throttle device 10 in the width direction Y can be reduced as compared with a configuration in which the second lever 26 is positioned to the right of the first lever 25.

[0084] As described above, each of the first lever 25 and the second lever 26 is supported by the rotary member 24. That is, the link mechanism including the first lever 25 and the link mechanism including the second lever 26 are independent from each other. Therefore, even when the link mechanism of the second lever 26 does not function, the link mechanism of the first lever 25 functions without being affected by the second lever 26 not functioning, and even when the link mechanism of the first lever 25 does not function, the link mechanism of the second lever 26 functions without being affected by the first lever 25 not functioning. In this sense, it can be said that the first lever 25 and the second lever 26 are provided in parallel with the rotary member 24. This is because there is no concept of upstream and downstream between the link mechanism of the first lever 25 and the link mechanism of the second lever. Rather, the rotary member 24 has a function of distributing the rotational force of the drive motor 41 to the two link mechanisms. The rotational force of the rotary member 24 is transmitted to the sensor shaft 23 not via the first lever 25, and similarly, the rotational force of the rotary member 24 is transmitted to the sensor shaft 23 not via the second lever 26. Thus, the first lever 25 and the second lever 26 are not in engagement with each other.

[0085] As illustrated in FIG. 4, the return spring 35 is a coil-shaped spring provided around the rotary member 24 and wound around the drive shaft 22. An axial direction of the return spring 35 coincides with the width direction Y of the throttle device 10. The return spring 35 is disposed at a position sandwiched between the rotary member 24 and the main body 41b of the drive motor 41. The return spring 35 biases the first throttle valve 12a and second throttle valve 12b in the closing direction. When the drive motor 41 does not output the rotational force, the return spring 35 positions the first throttle valve 12a and second throttle valve 12b to the fully closed position. When the drive motor 41 outputs the rotational force, the first throttle valve 12a and second throttle valve 12b rotate in the opening direction, resisting the biasing force of the return spring 35.

[0086] FIG. 5 shows a configuration of the return spring 35 of the present example. The rotary member 24 includes a locking part 24a. The locking part 24a is formed by bending a protrusion extending in a direction away from the drive shaft 22, toward the drive motor 41. A first end of the return spring 35 is fixed to the rotary member 24 by the locking part 24a. A second end of the return spring 35 is fixed to the throttle body 11 by a fixing screw 36. Meanwhile, an arrow illustrated in FIG. 5 denotes a biasing direction of the return spring.

[0087] Operations of the throttle shaft 21 and the drive shaft 22 will be exemplified. In FIG. 6, the throttle shaft 21 is at an initial angle. As described above, when the throttle shaft is at the initial angle, the first throttle valve 12a and second throttle valve 12b are in the fully closed position. One end of the first arm 20 is positioned close to the drive shaft 22. Another end of the first arm 20 is positioned away from the drive shaft 22.

[0088] FIG. 6 shows rotation directions E1 and E2 around the throttle shaft 21. FIG. 6 shows rotation directions F1 and F2 around the drive shaft 22. For example, the rotation direction E1 is a counterclockwise direction in a right side view of the two-wheel motor vehicle 1. For example, the rotation direction E2 is a clockwise direction in a right side view of the two-wheel motor vehicle 1.

[0089] When the drive shaft 22 rotates in a rotation direction F2, the rotary member 24 rotates integrally with the drive shaft 22 in the rotation direction F2. When the rotary member 24 rotates in the rotation direction F2, the first lever 25 pushes up the one end of the first arm 20. Therefore, when the rotary member 24 rotates in the rotation direction F2, the first arm 20 rotates in the rotation direction E2. When the first arm 20 rotates in the rotation direction E2, the throttle shaft 21 rotates integrally with the first arm 20 in the rotation direction E2. When the throttle shaft 21 rotates in the rotation direction E2, the first throttle valve 12a and second throttle valve 12b rotate in the opening direction.

[0090] FIG. 7 is a right side view of the throttle device 10. When the first arm 20 rotates in the rotation direction E2, the one end of the first arm 20 is finally pushed up to a position denoted by a broken line in FIG. 7.

[0091] When the first arm 20 is at the position denoted by the broken line in FIG. 7, the throttle shaft 21 is at a maximum angle. When the throttle shaft 21 is at the maximum angle, the first throttle valve 12a and second throttle valve 12b are in the fully open position. For example, when the drive shaft 22 rotates in the rotation direction F2, the first throttle valve 12a and second throttle valve 12b transition from the fully closed position to the fully open position.

[0092] Refer to FIG. 6. When the drive shaft 22 rotates in the rotation direction F1, the rotary member 24 rotates integrally with the drive shaft 22 in the rotation direction F1. When the rotary member 24 rotates in the rotation direction F1, the first arm 20 rotates in the rotation direction E1. When the first arm 20 rotates in the rotation direction E1, the throttle shaft 21 rotates integrally with the first arm 20 in the rotation direction E1. When the throttle shaft 21 rotates in the rotation direction E1, the first throttle valve 12a and second throttle valve 12b rotate in the closing direction. For example, the first throttle valve 12a and second throttle valve 12b transition from the fully open position to the fully closed position.

[0093] As described above, when the drive shaft 22 moves in the rotation direction F2, the first throttle valve 12a and second throttle valve 12b rotate in the opening direction. When the drive shaft 22 moves in the rotation direction F1 the first throttle valve 12a and second throttle valve 12b rotate in the closing direction.

[0094] Operations of the drive shaft 22 and the sensor shaft 23 will be exemplified. In Figure 6, the sensor shaft 23 is at the initial angle.

[0095] FIG. 6 shows a first direction G1 and a second direction G2 around the sensor shaft 23.

[0096] When the drive shaft 22 rotates in a rotation direction F2, the rotary member 24 rotates integrally with the drive shaft 22 in the rotation direction F2. When the rotary member 24 rotates in the rotation direction F2, the second lever 26 causes the second arm 27 in an upright posture to lie down flat. Therefore, when the rotary member 24 rotates in the rotation direction F2, the second arm 27 rotates in the second direction G2. When the second arm 27 rotates in the second direction G2, the sensor shaft 23 rotates integrally with the second arm 27 in the second direction G2.

[0097] When the drive shaft 22 rotates in the rotation direction F1, the rotary member 24 rotates integrally with the drive shaft 22 in the rotation direction F1. When the rotary member 24 rotates in the rotation direction F1, the second arm 27 rotates in the first direction G1. When the second arm 27 rotates in the first direction G1, the sensor shaft 23 rotates integrally with the second arm 27 in the first direction G1.

[0098] Therefore, when the first throttle valve 12a and second throttle valve 12b rotate in the opening direction, the sensor shaft 23 rotates in the second direction G2. When the first throttle valve 12a and second throttle valve 12b rotate in the closing direction, the sensor shaft 23 rotates in the first direction G1.

[0099] The rotation angle of the sensor shaft 23 corresponds to a position that the first throttle valve 12a and second throttle valve 12b are in. Therefore, the throttle position sensor 42 detects the position that the first throttle valve 12a and second throttle valve 12b are in.

[0100] The return spring 35 biases the rotary member 24 in the rotation direction F1. When the drive motor 41 does not function, the rotary member 24 rotates in the rotation direction F1. Therefore, when the drive motor 41 does not output the rotational force, the throttle shaft 21 is at the initial angle, and the first throttle valve 12a and second throttle valve 12b are in the fully closed position. When the drive motor 41 does not output rotational force, the sensor shaft 23 is at the initial angle.

[0101] When the rotary member 24 is rotated in the rotation direction F2 by the drive motor 41, the drive motor 41 is required to apply, to the rotary member 24, rotational force that can resist the biasing force of the return spring 35.

4. Stopper mechanisms

[0102] The throttle device 10 in the present example is provided with two stopper mechanisms that limit the rotation operation of the throttle shaft 21, and is provided with one stopper mechanism that limits the rotation operation of the sensor shaft 23. Configurations of these stopper mechanisms will be described.

[0103] Refer to FIG. 6. A first stopper mechanism S1 is a mechanism that forbids the first throttle valve 12a from further rotating in the closing direction when the first throttle valve 12a is in the fully closed position. The first stopper mechanism S1 will be specifically described. The first stopper mechanism S1 includes a fully closed position limiter 15 coupled to the throttle body 11 and a first protrusion 20a coupled to the throttle shaft 21. As illustrated in FIG. 2, the first arm 20 mounted on the throttle shaft 21 has the one end extending from the throttle shaft 21 toward the first lever 25 and the another end extending in a direction away from the first lever 25 with the throttle shaft 21 as a starting point. The another end of the first arm 20 has a T shape. The first protrusion 20a is disposed on the another end of the first arm 20. The first protrusion 20a protrudes in the rotation direction E1. The throttle body 11 is provided with the fully closed position limiter 15 that abuts on the first protrusion 20a. The fully closed position limiter 15 corresponds to a first limiter of the present invention. The first protrusion 20a corresponds to a first rotation contact part of the present invention. The first protrusion 20a and the fully closed position limiter 15 constitute the first stopper mechanism S1 of the present invention. When the first throttle valve 12a and second throttle valve 12b are in the fully closed position, the first protrusion 20a is in contact with the fully closed position limiter 15. When the first throttle valve 12a and second throttle valve 12b are in the fully closed position, the fully closed position limiter 15 forbids the first throttle valve 12a and second throttle valve 12b from further rotating in the closing direction.

[0104] A second stopper mechanism S2 is a mechanism that forbids the sensor shaft 23 from further rotating in the first direction G1 when the first throttle valve 12a is in the fully closed position. The second stopper mechanism S2 will be specifically described. The second stopper mechanism S2 includes a sensor shaft limiter 17 coupled to the throttle body 11 and a protrusion 27a coupled to the sensor shaft 23. The second arm 27 mounted on the sensor shaft 23 has the one end extending from the sensor shaft 23 toward the second lever 26 and the another end extending in a direction away from the second lever 26 with the sensor shaft 23 as a starting point. The protrusion 27a is provided on the another end of the second arm 27. The protrusion 27a protrudes in the first direction G1. The throttle body 11 is provided with the sensor shaft limiter 17 that abuts on the protrusion 27a. The sensor shaft limiter 17 corresponds to a second limiter of the present invention. The protrusion 27a corresponds to a second rotation contact part of the present invention. The protrusion 27a and the sensor shaft limiter 17 constitute the second stopper mechanism S2 of the present invention. When the first throttle valve 12a and second throttle valve 12b are in the fully closed position, the protrusion 27a is in contact with the sensor shaft limiter 17. The sensor shaft limiter 17 is a mechanism that forbids the sensor shaft 23 from further rotating in the first direction G1 when the first throttle valve 12a and second throttle valve 12b are in the fully closed position.

[0105] A specific configuration of the second stopper mechanism S2 will be described. The sensor shaft limiter 17 includes an adjustment screw 17b supported by the throttle body 11. The protrusion 27a comes into contact with the adjustment screw 17b. A position of the adjustment screw 17b with respect to the throttle body 11 is easily adjusted.

[0106] Specifically, as illustrated in FIG. 2, the sensor shaft limiter 17 includes a lock nut 17a attached via the adjustment screw 17b to a support provided on the throttle body 11. The support has a screw hole screwed with the adjustment screw 17b. When the adjustment screw 17b is rotated in a forward direction, a tip of the adjustment screw 17b emerges from an opening of the screw hole, and when the adjustment screw 17b is rotated in a reverse direction, the tip of the adjustment screw 17b retreats from the opening of the screw hole in the support. Thus, the adjustment screw 17b can move forward and backward with respect to the throttle body 11. Note that the lock nut 17a is a nut screwed with the adjustment screw 17b, and is configured to fix the adjustment screw 17b to the throttle body 11.

[0107] Refer to FIG. 6. When the drive motor 41 does not output the rotational force, the rotary member 24 rotates in the rotation direction F1 by the biasing force of the return spring 35, and the sensor shaft 23 rotates in the first direction G1. The rotation of the sensor shaft 23 in the first direction G1 continues until the protrusion 27a of the second arm 27 abuts on the adjustment screw 17b of the sensor shaft limiter 17 and stops.

[0108] By adjusting the position of the adjustment screw 17b with respect to the throttle body 11, a contact position between the protrusion 27a and the adjustment screw 17b is adjusted. When the contact position between the protrusion 27a and the adjustment screw 17b is adjusted, the initial angle of the sensor shaft 23 is adjusted. More specifically, when the contact position between the protrusion 27a and the adjustment screw 17b is adjusted, a timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 is adjusted. In this manner, the second stopper mechanism S2 including the protrusion 27a and the sensor shaft limiter 17 regulates the sensor shaft 23 so that the sensor shaft 23 does not rotate in the first direction G1 anymore. The second stopper mechanism S2 sets the initial angle of the sensor shaft 23. The adjustment screw 17b adjusts the initial angle of the sensor shaft 23.

[0109] By adjusting the adjustment screw 17b, for example, an angle of the sensor shaft 23 corresponding to the first throttle valve 12a and second throttle valve 12b in a fully closed state can be adjusted. For example, it is easy to adjust the initial angle of the sensor shaft 23 on the basis of the fully closed position of the first throttle valve 12a and second throttle valve 12b. For example, it is easy to adjust the initial angle of the sensor shaft 23 on the basis of the initial angle of the throttle shaft 21. For example, it is easy to match the timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 with a timing at which the first stopper mechanism S1 stops the rotation of the first throttle valve 12a and second throttle valve 12b in the closing direction.

[0110] The fully closed position limiter 15 of the first stopper mechanism S1 has a configuration similar to a configuration of the sensor shaft limiter 17. The fully closed position limiter 15 includes an adjustment screw 15b. The adjustment screw 15b has a structure similar to a structure of the adjustment screw 17b. The fully closed position limiter 15 includes a lock nut 15a. The lock nut 15a is configured to fix the adjustment screw 15b to the throttle body 11.

[0111] When the drive motor 41 is stopped, the rotary member 24 rotates in the rotation direction F1 by the biasing force of the return spring 35, and the throttle shaft 21 rotates in the rotation direction E1. The rotation continues until the first protrusion 20a of the first arm 20 abuts on the adjustment screw 15b of the fully closed position limiter 15 and stops.

[0112] By adjusting the position of the adjustment screw 15b with respect to the throttle body 11, a contact position between the first protrusion 20a and the adjustment screw 15b is adjusted. When the contact position between the first protrusion 20a and the adjustment screw 15b is adjusted, the initial angle of the throttle shaft 21 is adjusted. In this manner, the first stopper mechanism S 1 including the first protrusion 20a and the fully closed position limiter 15 regulates the throttle shaft 21 so that the throttle shaft 21 does not rotate in the rotation direction E1 anymore. The first stopper mechanism S1 sets the initial angle of the throttle shaft 21. The adjustment screw 15b adjusts the initial angle of the throttle shaft 21.

[0113] When the initial angle of the throttle shaft 21 is changed by the adjustment screw 15b, the fully closed position of the first throttle valve 12a and second throttle valve 12b are changed. Therefore, the fully closed position limiter 15 has a configuration that allows fine adjustment of the fully closed position of the first throttle valve 12a and second throttle valve 12b.

[0114] A third stopper mechanism S3 is a mechanism that forbids the first throttle valve 12a from further rotating in the opening direction when the first throttle valve 12a is in the fully open position. The third stopper mechanism S3 will be specifically described. The third stopper mechanism S3 includes a fully open position limiter 16 coupled to the throttle body 11 and a second protrusion 20b coupled to the throttle shaft 21. The second protrusion 20b is provided on the another end of the first arm 20. The second protrusion 20b protrudes in the rotation direction E2.

[0115] The fully open position limiter 16 has a similar configuration to the sensor shaft limiter 17. The fully open position limiter 16 includes an adjustment screw 16b and a lock nut 16a. The adjustment screw 16b has a structure similar to a structure of the adjustment screw 17b. The lock nut 16a is configured to fix the adjustment screw 16b to the throttle body 11.

[0116] When the drive motor 41 outputs maximum rotational force, the rotational force of the drive motor 41 overcomes the biasing force of the return spring 35 and rotates the throttle shaft 21 in the rotation direction E2. The rotation of the throttle shaft 21 in the rotation direction E2 continues until the second protrusion 20b of the first arm 20 abuts on the adjustment screw 16b of the fully open position limiter 16 and stops.

[0117] By adjusting the position of the adjustment screw 16b with respect to the throttle body 11, a contact position between the second protrusion 20b and the adjustment screw 16b is adjusted. When the contact position between the second protrusion 20b and the adjustment screw 16b is adjusted, a maximum value (maximum angle) of the rotation of the throttle shaft 21 is adjusted. In this manner, the third stopper mechanism S3 including the second protrusion 20b and the fully open position limiter 16 regulates the throttle shaft 21 so that the throttle shaft 21 does not rotate in the rotation direction E2 anymore. The third stopper mechanism S3 sets the maximum angle of the throttle shaft 21. The adjustment screw 16b adjusts the maximum angle of the throttle shaft 21.

[0118] In FIG. 6, the first throttle valve 12a and second throttle valve 12b are in the fully closed position. In FIG. 6, each of the fully closed position limiter 15, the fully open position limiter 16, and the sensor shaft limiter 17 is appropriately adjusted. That is, in FIG. 6, the first protrusion 20a of the first arm 20 abuts on the fully closed position limiter 15, and the protrusion 27a of the second arm 27 abuts on the sensor shaft limiter 17. As a result, the throttle shaft 21 does not rotate in the rotation direction E1. The first throttle valve 12a and second throttle valve 12b do not rotate in the closing direction. The first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position. The sensor shaft 23 does not rotate in the first direction G1.

[0119] As described above, a movable part between the first transmission member 13 and the rotary member 24 has backlash. The backlash slightly allows the drive shaft 22 to rotate in a state where the throttle shaft 21 is stationary. Therefore, the drive shaft 22 may slightly rotate in the rotation direction F1 in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position. This means that the drive shaft 22 may rotate by the backlash in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position.

[0120] If the throttle device 10 does not include the second stopper mechanism S2, the sensor shaft 23 may rotate slightly according to the slight rotation of the drive shaft 22 allowed by the backlash described above. This means that, if the throttle device 10 does not include the second stopper mechanism S2, the sensor shaft 23 may rotate in the first direction G1 in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position.

[0121] If the adjustment screw 17b as the sensor shaft limiter 17 is slightly moved to rearward Re in the state in FIG. 6, the protrusion 27a may move to the rearward Re and continue to be on the sensor shaft limiter 17. This means that when the adjustment screw 17b is moved slightly rearward Re, the sensor shaft 23 may rotate slightly in the first direction G1.

[0122] For example, in a case where the sensor shaft limiter 17 is not appropriately adjusted, the sensor shaft 23 may rotate after the first stopper mechanism S 1 forbids the rotation of the throttle shaft 21. Therefore, the sensor shaft 23 may rotate in the first direction G1 or the second direction G2 in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position. This means that the rotation angle of the sensor shaft 23 changes in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position.

[0123] When the adjustment screw 17b moves slightly rearward Re, an event in which the sensor shaft 23 rotates slightly in the first direction G1 is referred to as excessive rotation of the sensor shaft 23. The excessive rotation of the sensor shaft 23 adversely affects detection accuracy of the opening degree of the first throttle valve 12a and second throttle valve 12b. In a case where the rotation angle of the sensor shaft 23 changes in a state where the first throttle valve 12a and second throttle valve 12b are stationary in the fully closed position, the position the first throttle valve 12a and second throttle valve 12b are in is not accurately reflected in the rotation angle of the sensor shaft 23. When the position the first throttle valve 12a and second throttle valve 12b are in is not accurately reflected in the rotation angle of the sensor shaft 23, it is difficult for the throttle position sensor 42 to accurately detect the position that the first throttle valve 12a and second throttle valve 12b are in.

[0124] As described above, in FIG. 6, each of the fully closed position limiter 15 and the sensor shaft limiter 17 is appropriately adjusted. Therefore, as the first arm 20 starts to rotate, the second arm 27 starts to rotate. That is, in FIG. 6, the excessive rotation of the sensor shaft 23 does not actually occur.

[0125] Refer to FIG. 7. Similarly to FIG. 6, FIG. 7 shows a case where the fully closed position limiter 15 and the sensor shaft limiter 17 are appropriately adjusted. As can be seen with reference to FIG. 7, when the throttle shaft 21 rotates in the rotation direction E2 from the initial angle, a gap D1 is generated between the fully closed position limiter 15 and the first protrusion 20a. When the sensor shaft 23 rotates in the second direction G2 from the initial angle, a gap D2 is generated between the sensor shaft limiter 17 and the protrusion 27a.

[0126] The sensor shaft 23 rotates at the same time as the throttle shaft 21 rotates. A timing at which the throttle shaft 21 starts to rotate in the rotation direction E2 from the initial angle coincides with a timing at which the sensor shaft 23 starts to rotate in the second direction G2 from the initial angle. Therefore, the gap D1 and the gap D2 are simultaneously generated. Therefore, the throttle position sensor 42 can accurately detect the position that the first throttle valve 12a and second throttle valve 12b are in.

[0127] For example, even when the first throttle valve 12a and second throttle valve 12b rotate in the opening direction from the fully closed position, the timing at which the sensor shaft 23 starts to rotate in the second direction G2 coincides with a timing at which the first throttle valve 12a and second throttle valve 12b start to rotate in the opening direction. Therefore, even when the first throttle valve 12a and second throttle valve 12b rotate in the opening direction from the fully closed position, the throttle position sensor 42 can accurately detect the position that the first throttle valve 12a and second throttle valve 12b are in.

[0128] The timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 coincides with the timing at which the first stopper mechanism S1 stops the rotation of the first throttle valve 12a in the closing direction. Therefore, even when the first throttle valve 12a and second throttle valve 12b rotate in the closing direction to the fully closed position, the throttle position sensor 42 can accurately detect the position that the first throttle valve 12a and second throttle valve 12b are in.

[0129] FIG. 8 shows the throttle device 10 when the adjustment of the sensor shaft limiter 17 is intentionally shifted from the state in FIG. 6 for description. When the adjustment screw 17b is moved rearward Re, the protrusion 27a follows the adjustment screw 17b. That is, the second arm 27 and the sensor shaft 23 slightly rotate in the first direction G1, and the drive shaft 22 slightly rotates in the rotation direction F1. The rotation of the sensor shaft 23 in the first direction G1 is derived from the biasing force of the return spring 35. The rotation of the drive shaft 22 in the rotation direction F1 is also derived from the biasing force of the return spring 35.

[0130] The throttle shaft 21 does not rotate regardless of the rotation of the sensor shaft 23. This is because the rotation of the throttle shaft 21 in the rotation direction E1 is forbidden by the first protrusion 20a of the first arm 20 abutting on the fully closed position limiter 15. Because there is a clearance in each link mechanism, the sensor shaft 23 rotates in the first direction G1 even though the throttle shaft 21 is stopped. The clearance impairs synchronization between the rotation of the throttle shaft 21 and the rotation of the sensor shaft 23.

[0131] That is, if the sensor shaft limiter 17 is not appropriately adjusted, an event that the sensor shaft 23 and the throttle shaft 21 do not start to rotate at the same time may occur. If the second stopper mechanism S2 does not stop the rotation of the sensor shaft 23 at an appropriate timing, the rotation angle of the sensor shaft 23 may change in a state where the throttle shaft 21 is not rotating.

[0132] The throttle position sensor 42 detects the rotation of the sensor shaft 23 to estimate the position that the first throttle valve 12a and second throttle valve 12b are in. Therefore, if the rotation of the throttle shaft 21 and the rotation of the sensor shaft 23 are not synchronized with each other, detection accuracy of the throttle position sensor 42 decreases. For example, the throttle position sensor 42 erroneously detects that the throttle shaft 21 is rotating although the throttle shaft 21 is not actually rotating. For example, when the first throttle valve 12a is not actually rotating, the throttle position sensor 42 acquires an erroneous detection result indicating that the first throttle valve 12a is rotating.

[0133] FIGS. 9 to 11 illustrate a method for adjusting the sensor shaft limiter 17. FIG. 9 shows a state where the adjustment screw 17b as the sensor shaft limiter 17 is moved slightly forward F from the state in FIG. 8. As the adjustment screw 17b moves, the second arm 27 and the sensor shaft 23 rotate in the second direction G2. However, the throttle shaft 21 remains stopped. Because there is a clearance in each link mechanism, the throttle shaft 21 remains stopped even though the sensor shaft 23 rotates in the second direction G2.

[0134] FIG. 10 shows a state where the adjustment screw 17b as the sensor shaft limiter 17 is moved further forward F from the state in FIG. 9. As the adjustment screw 17b moves, the sensor shaft 23 rotates further in the second direction G2. When the sensor shaft 23 is rotated to a predetermined angle, the rotation angle of the sensor shaft 23 exceeds an angle that can be allowed by the clearance of each link mechanism. Thereafter, the first arm 20 and the throttle shaft 21 start to rotate in the rotation direction E2.

[0135] FIG. 11 shows a state where the adjustment screw 17b as the sensor shaft limiter 17 is moved rearward Re from the state in FIG. 10. When the adjustment screw 17b moves rearward Re, the protrusion 27a follows the adjustment screw 17b and continues to be on the adjustment screw 17b. The sensor shaft 23 rotates in the first direction G1. The drive shaft 22 rotates in the rotation direction F1. The throttle shaft 21 rotates in the rotation direction E1.

[0136] FIG. 11 shows a moment when the first protrusion 20a of the first arm 20 abuts on the fully closed position limiter 15. The position of the adjustment screw 17b at the moment when the first protrusion 20a abuts on the fully closed position limiter 15 is optimal. Therefore, the adjustment screw 17b is fixed to the position of the adjustment screw 17b at the moment when the first protrusion 20a abuts on the fully closed position limiter 15. That is, the sensor shaft limiter 17 is appropriately adjusted. As a result, the second stopper mechanism S2 appropriately adjusts the initial angle of the sensor shaft 23. The rotation angle of the sensor shaft 23 is adjusted so that the sensor shaft 23 starts to rotate at the same time as the throttle shaft 21 starts to rotate.

[0137] The position of the adjustment screw 17b in FIG. 11 is substantially the same as the position of the adjustment screw 17b in FIG. 6.

[0138] When the throttle shaft 21 is at the initial angle, the angle of the sensor shaft 23 may be within a certain range (from $-\theta$ to $+\theta$). The angle of the sensor shaft 23 in FIG. 11 is defined to be at an end ($+\theta$) in the second direction G2 within the certain range. The angle $+\theta$ is an angle does not allow the clearance of the link mechanism to act on the rotation of the throttle shaft 21. Therefore, when the sensor shaft limiter 17 is adjusted as illustrated in FIG. 11, each link mechanism operates as if there is no clearance. As a result, the rotation angle of the sensor shaft 23 is proportional to the rotation angle of the throttle shaft 21. The throttle position sensor 42 accurately detects the rotation of the throttle shaft 21. The throttle position sensor 42 accurately detects the position that the first throttle valve 12a and second throttle valve 12b are in.

[0139] It is possible to adjust the sensor shaft limiter 17 appropriately by performing operation described with reference to FIGS. 8 to 11. That is, the operation described with reference to FIGS. 8 to 11 is an example of a procedure for adjusting the sensor shaft limiter 17. A procedure for adjusting the sensor shaft limiter 17 will be described below. Firstly, the adjustment screw 17b is moved forward F in a state where the first protrusion 20a is in contact with the fully closed position limiter 15. As a result, the sensor shaft 23 is rotated in the second direction G2, the drive shaft 22 is rotated in the rotation direction F2, the throttle shaft 21 is rotated in the rotation direction E2, and the first protrusion 20a is separated from the fully closed position limiter 15. Secondly, the adjustment screw 17b is moved rearward Re. As a result, the sensor shaft 23 is rotated in the first direction G1, the drive shaft 22 is rotated in the rotation direction F1, and the throttle shaft 21 is rotated in the rotation direction E1. Then, the movement of the adjustment screw 17b is stopped when the first protrusion 20a abuts on the fully closed position limiter 15. Then, the adjustment screw

17b is fixed to the position.

[0140] If the sensor shaft limiter 17 is appropriately adjusted in a configuration of the embodiment, when the first throttle valve 12a and second throttle valve 12b shift in the opening direction from the fully closed position, the timing at which the sensor shaft 23 starts to rotate in the second direction G2 coincides with a timing at which the first throttle valve 12a and second throttle valve 12b start to rotate in the opening direction.

[0141] In addition, if the sensor shaft limiter 17 is appropriately adjusted in the configuration of the embodiment, the timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 coincides with the timing at which the first stopper mechanism S1 stops the rotation of the first throttle valve 12a and second throttle valve 12b in the closing direction. Such timing adjustment can be easily achieved by the adjustment of the adjustment screw 17b described with reference to FIGS. 8 to 11.

5. Other Configurations

[0142] Refer to FIG. 4. The two-wheel motor vehicle 1 includes a motor controller 61. The motor controller 61 includes, for example, an electronic control unit (ECU). Note that the motor controller 61 is not necessarily implemented by the ECU, and may include a control device for a throttle device, the control device being controlled by the ECU. The motor controller 61 is connected to the drive motor 41 via wiring shown in FIG. 4, and the motor controller 61 controls the rotational force of the drive motor 41 by modulating a pulse width of a control signal output to the drive motor 41. When the drive motor 41 is caused not to generate rotational force, the motor controller 61 does not output, to the drive motor 41, a pulse signal related to control. When the drive motor 41 does not generate the rotational force, the first throttle valve 12a and second throttle valve 12b are in the fully closed state, and the first transmission member 13 and the second transmission member 14 are in the states shown in FIGS. 6 and 11.

[0143] When the driver operates the accelerator, the motor controller 61 transmits, to the drive motor 41, a control signal of which a duty ratio is to be indicated. The drive motor 41 generates the rotational force in accordance with the control signal. Here, when the duty ratio is lower than a predetermined value, the rotational force of the drive motor 41 cannot resist the biasing force of the return spring 35. As a result, the angle of the throttle shaft 21 does not change from the initial angle. When the duty ratio is the predetermined value or more, the drive motor 41 rotates the throttle shaft 21 in the rotation direction E2, resisting the biasing force of the return spring 35. Then, the throttle shaft 21 stops rotating when the rotational force of the drive motor 41 and rotational force of the return spring 35 are balanced (refer to FIG. 7).

[0144] The more the throttle shaft 21 rotates in the rotation direction E2, the more strongly the return spring 35 apply a bias. Each time the duty ratio of the control signal is increased, the throttle shaft 21 rotates in the rotation direction F2. Then, the throttle shaft 21 stops when the biasing force of the return spring 35 and the rotational force of the drive motor 41 are balanced. When the duty ratio approaches 1, the second protrusion 20b of the first arm 20 abuts on the fully open position limiter 16, and the throttle shaft 21 no longer rotates in the rotation direction E2. Thus, the motor controller 61 is configured to change the opening degree of the first throttle valve 12a and second throttle valve 12b by controlling the duty ratio of the control signal.

[0145] Note that, in the present example, it is possible to cause a time point of accelerator operation by the driver and a time point of starting rotation of the first throttle valve 12a and second throttle valve 12b to be more coincident with each other. In order to do so, it is only required, before the accelerator operation, to continue to supply the drive motor 41 with a control signal having a duty ratio that is low enough that the throttle shaft 21 does not rotate. Then, the first throttle valve 12a and second throttle valve 12b are opened when the duty ratio is increased by the accelerator operation by the driver.

[0146] Note that output from the throttle position sensor 42 is input to the motor controller 61 and used for feedback control of the motor controller 61.

6. Effects of embodiment

[0147] The throttle device 10 includes the throttle body 11, the throttle shaft 21, and the first throttle valve 12a. The throttle body 11 has the intake passages V. The throttle shaft 21 is supported by the throttle body 11. The first throttle valve 12a is provided in the intake passage V The first throttle valve 12a is coupled to the throttle shaft 21. Therefore, the first throttle valve 12a rotates integrally with the throttle shaft 21. When the throttle shaft 21 rotates, the first throttle valve 12a opens and closes the intake passage V The rotation angle of the throttle shaft 21 corresponds to a position that the first throttle valve 12a is in.

[0148] The throttle device 10 includes the drive motor 41, the rotary member 24, the first transmission member 13, the sensor shaft 23, the second transmission member 14, and the throttle position sensor 42. The drive motor 41 has the drive shaft 22. The rotary member 24 is coupled to the drive shaft 22. The rotary member 24 rotates integrally with the drive shaft 22. The first transmission member 13 transmits rotational force of the rotary member 24 to the throttle shaft 21. The second transmission member 14 transmits the rotational force of the rotary member 24 to the sensor shaft 23. The throttle position sensor 42 detects a rotation angle of the sensor shaft 23. Therefore, when the drive shaft 22 rotates, the throttle shaft 21 and the sensor shaft 23 rotate. Therefore, the throttle position sensor 42 appropriately detects the position that the first throttle valve 12a is in.

[0149] The sensor shaft 23 is parallel with the throttle shaft 21. Therefore, the sensor shaft 23 is not disposed on the extension of the throttle shaft 21. Therefore, the throttle position sensor 42 is not disposed on the extension of the throttle shaft 21. Therefore, the throttle device 10 is small in size. For example, the throttle device 10 is short in the extending direction of the throttle shaft 21.

[0150] As described above, the drive motor 41 rotates the throttle shaft 21 via the first transmission member 13 and rotates the sensor shaft 23 via the second transmission member 14. That is, the throttle shaft 21 and the sensor shaft 23 are coupled in parallel with the drive motor 41. Therefore, flexibility of arrangement of the sensor shaft 23 is high. For example, the position of the sensor shaft 23 not limited by the throttle shaft 21. Therefore, it is also easy to arrange the sensor shaft 23 in parallel with the throttle shaft 21.

[0151] The rotational force of the rotary member 24 is transmitted to the sensor shaft 23 not via the first transmission member 13. Therefore, flexibility of arrangement of the sensor shaft 23 is high. For example, the position of the sensor shaft 23 not limited by the first transmission member 13.

[0152] The rotational force of the sensor shaft 23 in the embodiment is transmitted from the drive shaft 22, and the rotational force is transmitted not by the first transmission member 13 involving the rotation of the throttle shaft 21 but by the second transmission member 14 provided on the sensor shaft 23. Therefore, flexibility of arrangement of the sensor shaft 23 is high.

[0153] The first transmission member 13 includes the first lever 25 and the first arm 20. Therefore, it is easy for the first transmission member 13 to transmit the rotational force of the rotary member 24 to the throttle shaft 21.

[0154] The second transmission member 14 includes a second lever 25 and the second arm 27. Therefore, it is easy for the second transmission member 14 to transmit the rotational force of the rotary member 24 to the sensor shaft 23.

[0155] The distance between the sensor shaft 23 and the throttle shaft 21 is equal to or longer than a distance between the drive shaft 22 and the throttle shaft 21. Therefore, the distance between the drive shaft 22 and the throttle shaft 21 is relatively short. Therefore, it is easy to reduce a size of the first transmission member 13. Therefore, the first transmission member 13 efficiently transmits the rotational force of the rotary member 24 to the throttle shaft 21.

[0156] The distance between the sensor shaft 23 and the throttle shaft 21 is equal to or longer than a distance between the drive shaft 22 and the sensor shaft 23. Therefore, the distance between the drive shaft 22 and the sensor shaft 23 is relatively short. Therefore, it is easy to reduce a size of the second transmission member 14. Therefore, the second transmission member 14 efficiently transmits the rotational force of the rotary member 24 to the sensor shaft 23.

[0157] The distance between the sensor shaft 23 and the throttle shaft 21 is relatively long. Therefore, it is easy to prevent interference between the first transmission member 13 and the second transmission member 14.

[0158] At least a portion of the throttle position sensor 42 is at the same position as the drive shaft 22 in the extending direction of the drive shaft 22. Therefore, the throttle position sensor 42 and the drive shaft 22 can overlap each other in the extending direction of the drive shaft 22. Therefore, the throttle device 10 is even smaller in size. For example, the throttle device 10 is even short in the extending direction of the throttle shaft 21.

[0159] At least a portion of the drive shaft 22 is at the same position as the first throttle valve 12a in the extending direction of the drive shaft 22. At least a portion of the throttle position sensor 42 is at the same position as the first throttle valve 12a in the extending direction of the drive shaft 22. Therefore, the first throttle valve 12a and the drive shaft 22 can overlap each other in the extending direction of the drive shaft 22. The first throttle valve 12a and the throttle position sensor 42 can overlap each other in the extending direction of the drive shaft 22. Therefore, a size of the throttle device 10 in the extending direction of the throttle shaft 21 is further reduced. The drive shaft 22 and the throttle position sensor 42 are disposed near the first throttle valve 12a. That is, the drive shaft 22 and the throttle position sensor 42 are close to each other. Therefore, it is easy to reduce the size of the second transmission member 14.

[0160] The throttle device 10 includes the second throttle valve 12b. The first throttle valve 12a is disposed between the first transmission member 13 and the second throttle valve 12b along the throttle shaft 21. The drive shaft 22 is disposed between the first transmission member 13 and the second throttle valve 12b in the extending direction of the throttle shaft 21. At least a portion of the throttle position sensor 42 is disposed between the first transmission member 13 and the second throttle valve 12b in the extending direction of the throttle shaft 21. Therefore, the drive shaft 22 and the throttle position sensor 42 are disposed near the first throttle valve 12a. That is, the drive shaft 22 and the throttle position sensor 42 are close to each other. Therefore, it is easy to reduce a size of the second transmission member 14. The throttle device 10 includes two throttle valves, and the drive shaft 22 and the throttle position sensor 42 are disposed to be biased to the first throttle valve 12a. With this configuration, a size of a mechanism mechanically connecting the drive shaft 22 and the throttle position sensor 42 can be reduced.

[0161] The second transmission member 14 is provided between the first transmission member 13 and the drive motor 41 in the extending direction of the drive shaft 22. Therefore, for example, the entire second transmission member 14 is disposed to the left of the right end of the throttle shaft 21 and to the right of a left end of the throttle shaft 21. Therefore, it is easy to shorten the throttle device 10 in the extending direction of the throttle shaft 21.

[0162] The throttle device 10 includes the first stopper mechanism S1 and the second stopper mechanism S2. The first stopper mechanism S1 forbids the first throttle valve 12a from further rotating in the closing direction when the first throttle valve 12a is in the fully closed position. The second stopper mechanism S2 forbids the sensor shaft 23 from further rotating in the first direction G1 when the first throttle valve 12a is in the fully closed position. Therefore, in a state where the first throttle valve 12a is stationary in the fully closed position, the sensor shaft 23 is also stationary. In other words, in a state where the first throttle valve 12a is stationary in the fully closed position, the sensor shaft 23 is not rotating. In a state where the first throttle valve 12a is stationary in the fully closed position, the rotation angle of the sensor shaft 23 does not change. Therefore, the position that the first throttle valve 12a is in is accurately reflected in the rotation angle of the sensor shaft 23. Therefore, the throttle position sensor 42 appropriately detects the position that the first throttle valve 12a is in.

[0163] When the first throttle valve 12a shifts in the opening direction from the fully closed position, the timing at which the sensor shaft 23 starts to rotate in the second direction G2 coincides with a timing at which the first throttle valve 12a starts to rotate in the opening direction. A timing at which the first throttle valve 12a in the fully closed state starts to open coincides with a timing at which the sensor shaft 23 starts to rotate. Therefore, even when the first throttle valve 12a shifts in the opening direction from the fully closed position, the position the first throttle valve 12a is in is accurately reflected in the rotation angle of the sensor shaft 23. Therefore, even when the first throttle valve 12a shifts in the opening direction from the fully closed position, the throttle position sensor 42 accurately detects the position that the first throttle valve 12a is in.

[0164] The timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 coincides with the timing at which the first stopper mechanism S1 stops the rotation of the first throttle valve 12a in the closing direction. A timing at which the first throttle valve 12a enters the fully closed state coincides with a timing at which the sensor shaft 23 stops rotating. Therefore, when the first throttle valve 12a shifts in the opening direction from the fully closed position, it is easy to match the timing at which the sensor shaft 23 starts to rotate in the second direction G2 and the timing at which the first throttle valve 12a starts to rotate in the opening direction.

[0165] The first stopper mechanism S1 includes the fully closed position limiter 15 and the first protrusion 20a. Therefore, it is easy for the first stopper mechanism S1 to forbid the first throttle valve 12a from further rotating in the closing direction when the first throttle valve 12a is in the fully closed position. The second stopper mechanism S2 includes the sensor shaft limiter 17 and the protrusion 27a. Therefore, it is easy for the second stopper mechanism S2 to forbid the sensor shaft 23 from further rotating in the first direction G1 when the first throttle valve 12a is in the fully closed position.

[0166] The sensor shaft limiter 17 includes the adjustment screw 17b. Therefore, the adjustment screw 17b finely adjusts a timing at which the protrusion 27a comes into contact with the sensor shaft limiter 17. The adjustment screw 17b finely adjusts a timing at which the sensor shaft limiter 17 forbids the sensor shaft 23 from further rotating in the first direction. Therefore, for example, when the first throttle valve 12a shifts in the opening direction from the fully closed position, it is easy to match the timing at which the sensor shaft 23 starts to rotate in the second direction G2 and the timing at which the first throttle valve 12a starts to rotate in the opening direction. For example, it is easy to match the timing at which the second stopper mechanism S2 stops the rotation of the sensor shaft 23 in the first direction G1 with the timing at which the first stopper mechanism S1 stops the rotation of the first throttle valve 12a in the closing direction.

[0167] The straddled vehicle of the embodiment includes the throttle device 10. The throttle device 10 is small in size. Therefore, it is easy to mount the throttle device 10 on the straddled vehicle.

7. Modified embodiments

[0168] The present invention is not limited to the above-described configuration, and modifications can be made as follows.

<Modification 1>

[0169] The two-wheel motor vehicle 1 according to the above-described embodiment includes the two-cylinder type internal combustion engine 5. However, the present invention is not limited to this configuration. For example, the present invention may also be implemented for a two-wheel motor vehicle having a four-cylinder type internal combustion engine. As illustrated in FIG. 12, the two-wheel motor vehicle of the present modification has a throttle device 70 in which four intake passages V are arranged in series. As can be seen with reference to FIG. 12, the throttle device 70 of the present modification includes a first unit 10a including the throttle device 10 according to the embodiment and a second unit 10b that is mirror-symmetric to the throttle device 10 according to the embodiment. The first unit 10a and the second unit 10b are arranged in the width direction Y. For example, the first unit 10a and the second unit 10b are arranged in a direction in which fully closed position limiters 15 face each other. A width of the throttle device 70 of the present modification is wider than a width of the throttle device 70 according to the above-described embodiment. Therefore, an effect when the present invention is applied is greater.

<Modification 2>

[0170] The throttle device 10 includes the first unit 10a and the second unit 10b that are mirror-symmetric to each other In Modification 1 described above. However, the present invention is not limited to this configuration. For example, the throttle device 70 may include two first units 10a. Alternatively, the throttle device 70 may include two second units 10b. The two first units 10a or the two second units 10b are arranged in the width direction Y With such a configuration, the drive motor 41 is exposed in the width direction Y. Therefore, an effect of the present invention that can downsize the throttle device 10 is applied is greater.

<Modification 3>

[0171] The rotary member 24 and first transmission member 13 according to the above-described embodiment constitute a link mechanism. However, the present invention is not limited to this configuration. For example, the rotary member 24 and the first transmission member 13 may constitute a gear mechanism. Specifically, the rotary member 24 is a first gear. The first gear is coupled to the drive shaft 22. The first transmission member 13 is a second gear. The second gear is coupled to the throttle shaft 21. The first gear and the second gear are in engagement with each other. For example, the first gear and the second gear may directly mesh with each other. Alternatively, the first gear and the second gear may be in engagement with each other indirectly via an intermediate gear.

<Modification 4>

[0172] The rotary member 24 and second transmission member 14 according to the above-described embodiment constitute a link mechanism. However, the present invention is not limited to this configuration. For example, the rotary member 24 and the second transmission member 14 may constitute a gear mechanism. Specifically, the rotary member 24 is a first gear. The first gear is coupled to the drive shaft 22. The second transmission member 14 is a third gear. The third gear is coupled to the sensor shaft 23. The first gear and the third gear are in engagement with each other. For example, the first gear and the third gear may directly mesh with each other. Alternatively, the first gear and the third gear may be in engagement with each other indirectly via an intermediate gear.

<Modification 5>

[0173] The throttle device 10 according to the above-described embodiment is mounted on the two-wheel motor vehicle 1. However, the present invention is not limited to this configuration. The present invention can also be applied to other straddled vehicles. For example, in the embodiment, there is one front wheel 3. The number of the front wheel 3 is not limited thereto. For example, there may be two front wheels 3. For example, in the embodiment, there is one rear wheel 4. The number of the rear wheel 4 is also not limited thereto. There may be two rear wheels 4.

<Description of Reference Numerals>

[0174]

1	Two-wheel motor vehicle (straddled vehicle)
3	Front wheel
4	Rear wheel
5	Internal combustion engine
6	Front fork
10, 70	Throttle device
10a	First unit
10b	Second unit
11	Throttle body
12a	First throttle valve
12b	First throttle valve
13	First transmission member
14	Second transmission member
15	Fully closed position limiter (First limiter)
15a	Lock nut
15b	Adjustment screw
16	Fully open position limiter
16a	Lock nut
16b	Adjustment screw
17	Sensor shaft limiter (Second limiter)
17a	Lock nut
17b	Adjustment screw
20	First arm (First transmission member)
20a	First protrusion (First rotation contact part)
20b	Second protrusion
21	Throttle shaft
22	Drive shaft
23	Sensor shaft
24	Rotary member
24a	Locking part
25	First lever (First transmission member)
26	Second lever (Second transmission member)
27	Second arm (Second transmission member)
27a	Protrusion (Second rotation contact part)
31	Joint
32	Joint
33	Joint
34	Joint
35	Return spring
36	Fixing screw
41	Drive motor
41b	Main body
42	Throttle position sensor
51	Vehicle body frame
53	Seat
54	Handlebar
61	Motor controller
S1	First stopper mechanism
S2	Second stopper mechanism
S3	Third stopper mechanism

V Intake passage

Claims

1. A throttle device (10) comprising:

a throttle body (11) having an intake passage;
a throttle shaft (21) supported by the throttle body (11);
a first throttle valve (12a) provided in the intake passage and coupled to the throttle shaft (21);
a drive motor (41) having a drive shaft parallel with the throttle shaft (21);
a rotary member (24) coupled to the drive shaft and configured to rotate integrally with the drive shaft;
a first transmission member (25) configured to transmit rotational force of the rotary member (24) to the throttle shaft (21);
a sensor shaft (23) parallel with the throttle shaft (21);
a throttle position sensor (42) configured to detect a rotation angle of the sensor shaft (23); and
a second transmission member (26) configured to transmit rotational force of the rotary member (24) to the sensor shaft (23).

2. The throttle device (10) according to claim 1, wherein the rotational force of the rotary member (24) is transmitted to the sensor shaft (23) not via the first transmission member (25).

3. The throttle device (10) according to claim 1, wherein

the first transmission member (25) includes
a first lever (25) rotatably coupled to the rotary member (24), and
a first arm (20) rotatably coupled to the first lever, and
the first arm (20) is coupled to the throttle shaft (21).

4. The throttle device (10) according to claim 1, wherein

the second transmission member (26) includes
a second lever (26) rotatably coupled to the rotary member (24), and
a second arm (27) rotatably coupled to the second lever (26), and
the second arm (27) is coupled to the sensor shaft (23).

5. The throttle device (10) according to claim 1, wherein

a distance between the sensor shaft (23) and the throttle shaft (21) is equal to or longer than a distance between the drive shaft and the throttle shaft (21), and
the distance between the sensor shaft (23) and the throttle shaft (21) is equal to or longer than a distance between the drive shaft and the sensor shaft (23).

6. The throttle device (10) according to claim 1, wherein at least a portion of the throttle position sensor (42) is at the same position as the drive shaft in an extending direction of the drive shaft.

7. The throttle device (10) according to claim 1, wherein

at least a portion of the drive shaft is at the same position as the first throttle valve (12a) in an extending direction of the drive shaft, and
at least a portion of the throttle position sensor (42) is at the same position as the first throttle valve (12a) in the extending direction of the drive shaft.

8. The throttle device (10) according to claim 1, further comprising a second throttle valve provided in the intake passage and coupled to the throttle valve, wherein

the first throttle valve (12a) is disposed between the first transmission member (25) and the second throttle valve along with the throttle shaft (21),
the drive shaft is disposed between the first transmission member (25) and the second throttle valve in an extending direction of the throttle shaft (21), and
the throttle position sensor (42) is disposed between the first transmission member (25) and the second throttle valve in the extending direction of the throttle shaft (21).

9. The throttle device (10) according to claim 1, wherein the second transmission member (26) is provided between the first transmission member (25) and the drive motor (41) in an extending direction of the drive shaft.

10. The throttle device (10) according to claim 1, wherein

the sensor shaft (23) rotates in a first direction when the first throttle valve (12a) rotates in a closing direction, and
the throttle device (10) further includes
a first stopper mechanism (S1) that forbids the first throttle valve (12a) from further rotating in the closing direction when the first throttle valve (12a) is in a fully closed position, and
a second stopper mechanism (S2) that forbids the sensor shaft (23) from further rotating in the first direction when the first throttle valve (12a) is in the fully closed position.

11. The throttle device (10) according to claim 10, wherein

the sensor shaft (23) rotates in a second direction when the first throttle valve (12a) rotates in an opening direction, and
when the first throttle valve (12a) shifts in the opening direction from the fully closed position, a timing at which the sensor shaft (23) starts to rotate in the second direction coincides with a timing at which the first throttle valve (12a) starts to rotate in the opening direction.

12. The throttle device (10) according to claim 10, wherein
a timing at which the second stopper mechanism (S2) stops rotation of the sensor shaft (23) in the first direction coincides with a timing at which the first stopper mechanism (S1) stops rotation of the first throttle valve (12a) in the closing direction.

13. The throttle device (10) according to claim 10, wherein

the first stopper mechanism (S1) includes
a first limiter (15) coupled to the throttle body (11), and
a first rotation contact part (20a) coupled to the throttle shaft (21), and
when the first throttle valve (12a) is in the fully closed position, the first rotation contact part (20a) is in contact with the first limiter (15), and the first limiter (15) forbids the first throttle valve (12a) from further rotating in the closing direction, and
the second stopper mechanism (S2) includes
a second limiter (17) coupled to the throttle body (11), and
a second rotation contact part (27a) coupled to the sensor shaft (23), and
when the first throttle valve (12a) is in the fully closed position, the second rotation contact part (27a) is in contact with the second limiter (17), and the second limiter (17) forbids the sensor shaft (23) from further rotating in the first direction.

14. The throttle device (10) according to claim 13, wherein
the second limiter (17) is an adjustment screw supported by the throttle body (11).

15. A straddled vehicle including the throttle device (10) according to any one of the foregoing claims.

Fig. 1

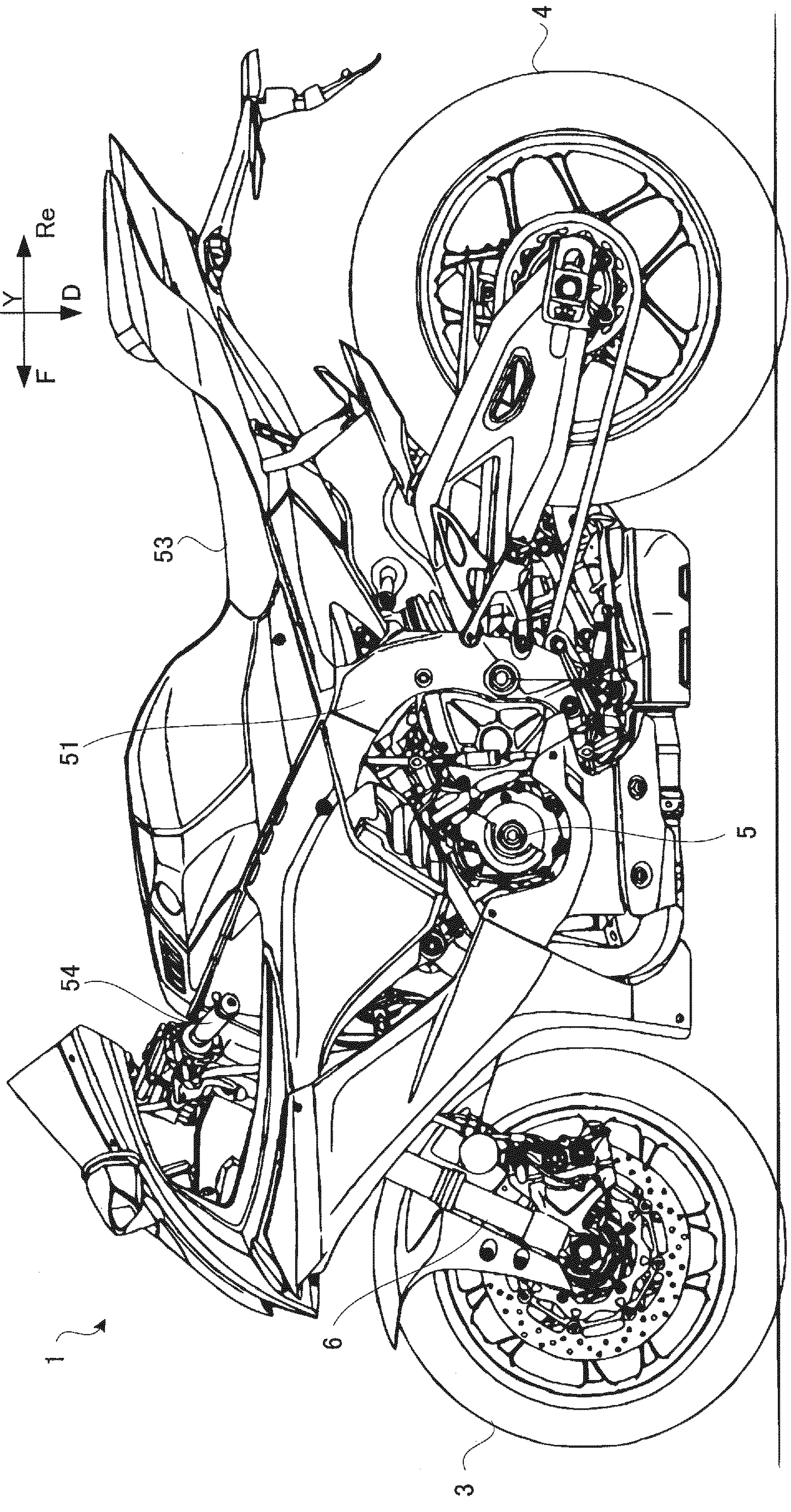
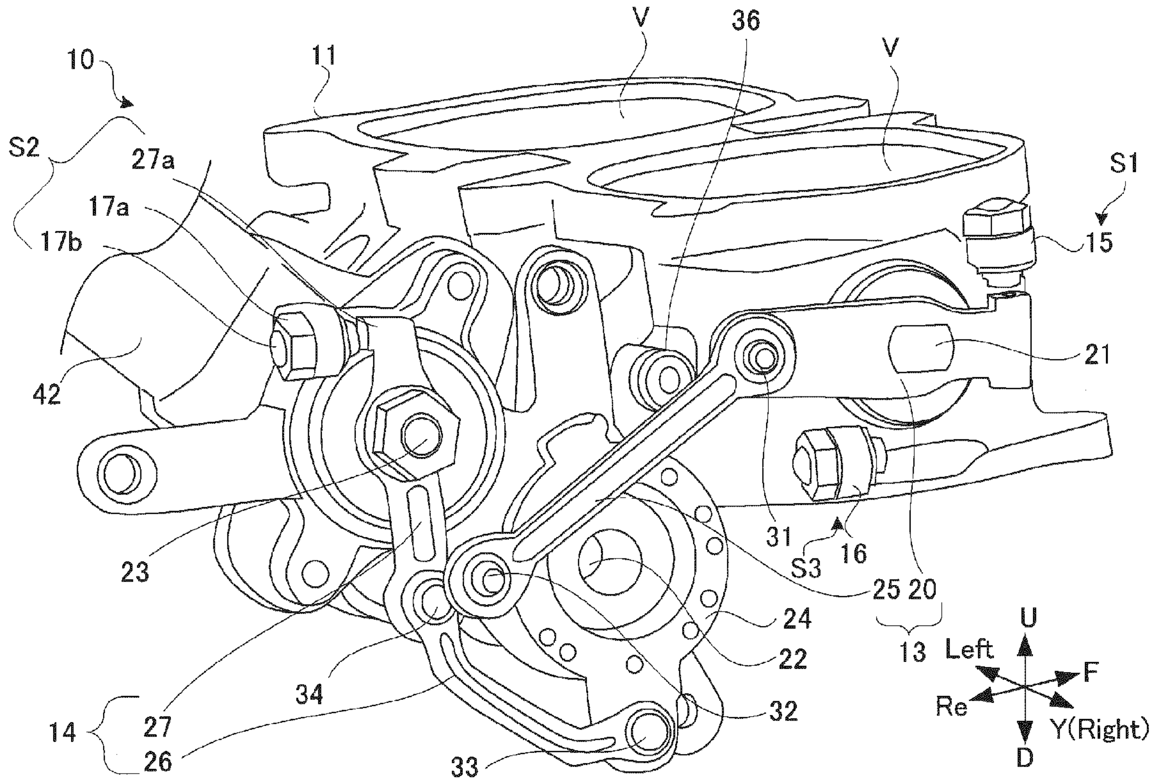


Fig. 2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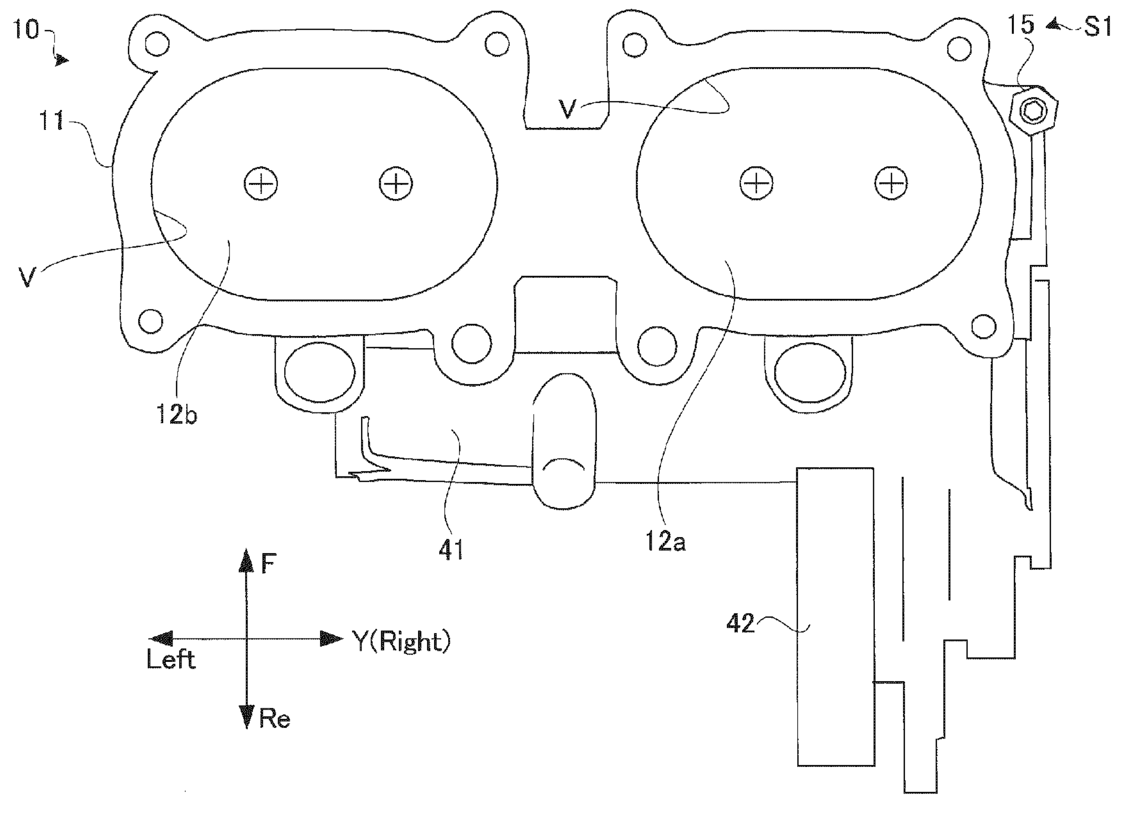
11
V
36
V
S1
15
S2
27a
17a
17b
42
21
23
31
16
S3
25 20
13
24
22
34
32
14
27
26
33
U
Left
F
Re
Y(Right)
D

Fig. 3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15
S1
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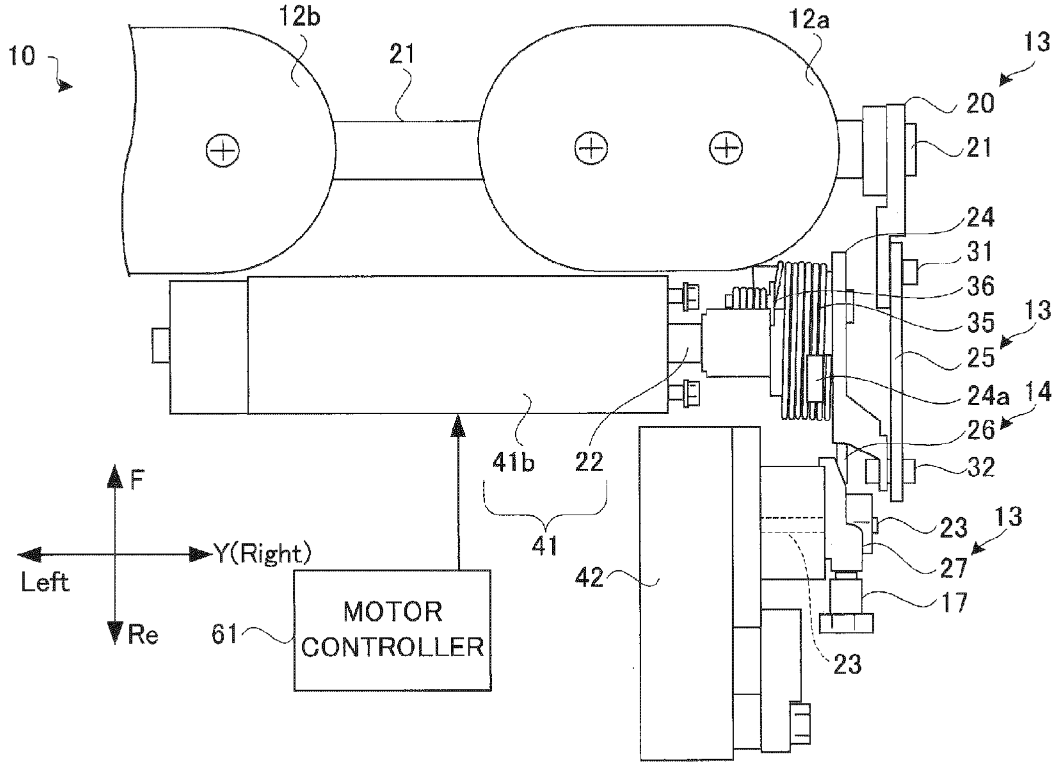
V
V
12b
41
12a
42
F
Left
Y(Right)
Re

Fig. 4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12b
21
12a
13
20
21
24
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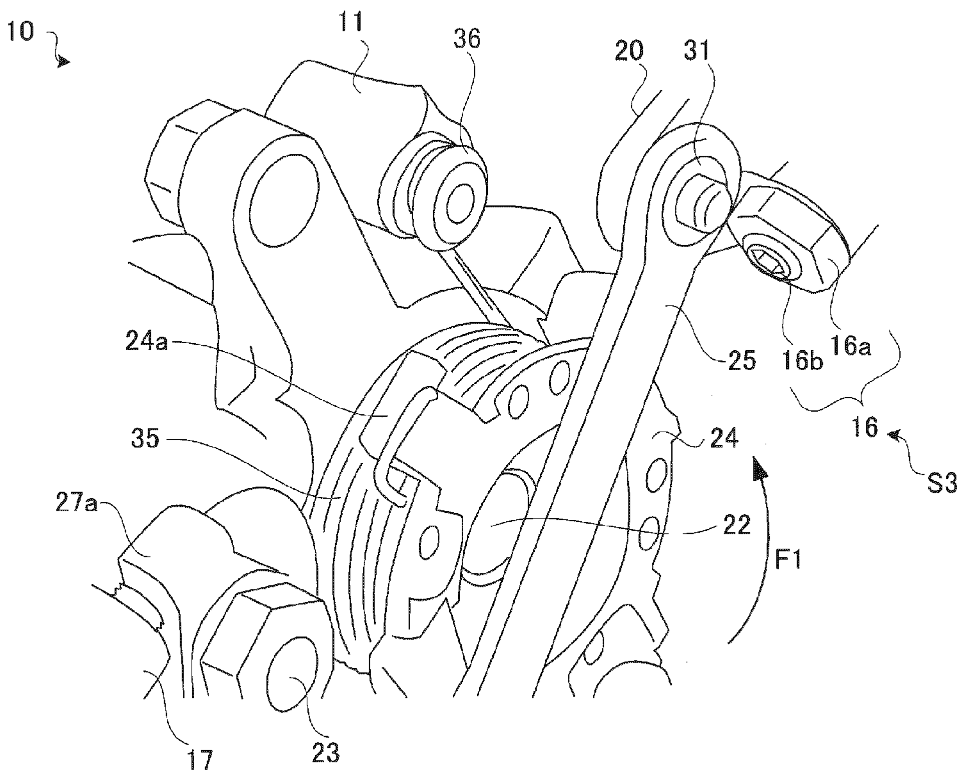
36
35
13
25
24a
14
26
32
41b
22
41
23
13
27
17
23
42
F
Y(Right)
Left
Re
61
MOTOR
CONTROLLER

Fig. 5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11
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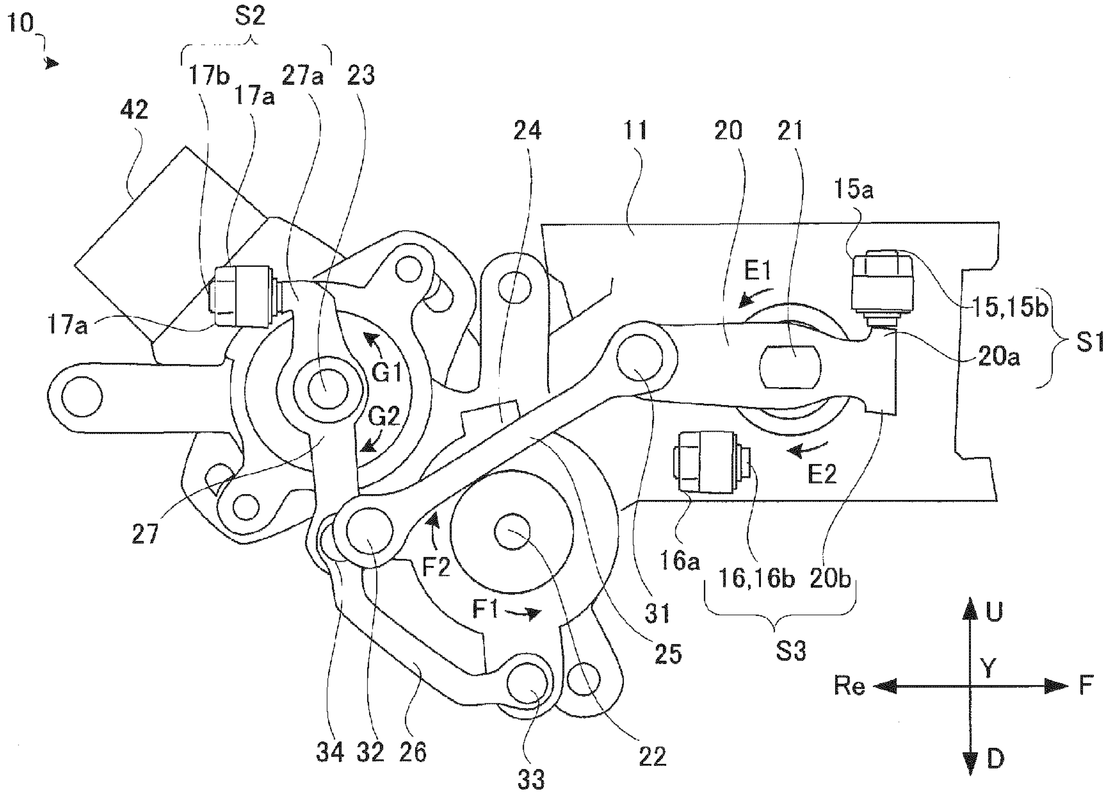
24a
25
16b
16a
16
S3
35
24
22
27a
F1
17
23

Fig. 6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S2
17b
17a
27a
23
42
24
11
20
21
15a
E1
15,15b
S1
20a
17a
G1
G2
E2
27
F2
16a
16,16b
20b
F1
31
25
S3
U
Y
Re
F
D
34
32
26
33
22

Fig. 7

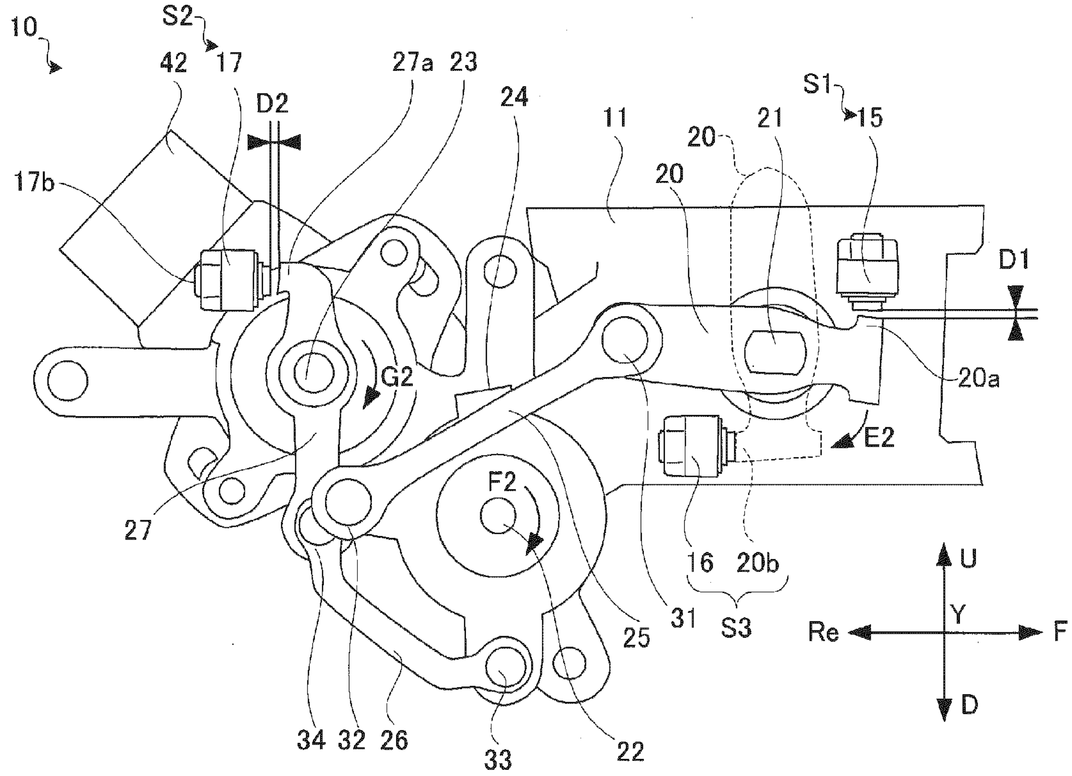
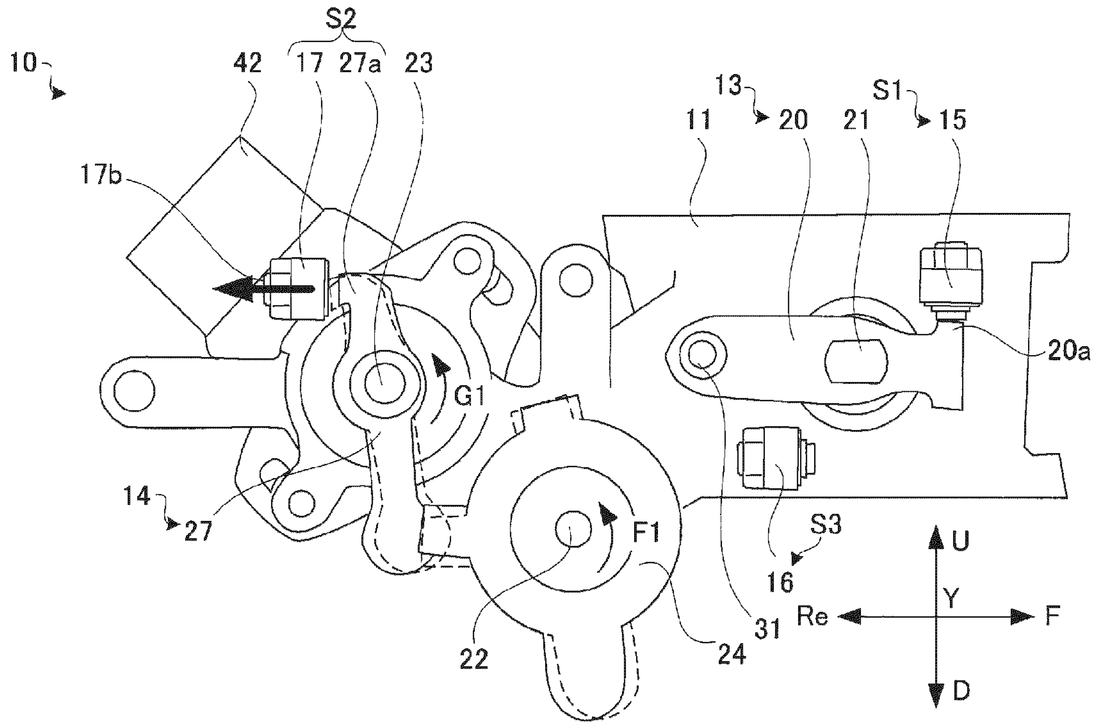

10
S2
17
42
27a
23
D2
24
S1
15
11
21
20
20
17b
D1
20a
G2
E2
F2
27
16
20b
U
31
S3
25
Y
Re
F
D
34
32
26
33
22

Fig. 8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27a
23
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S1
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20
21
15
17b
20a
G1
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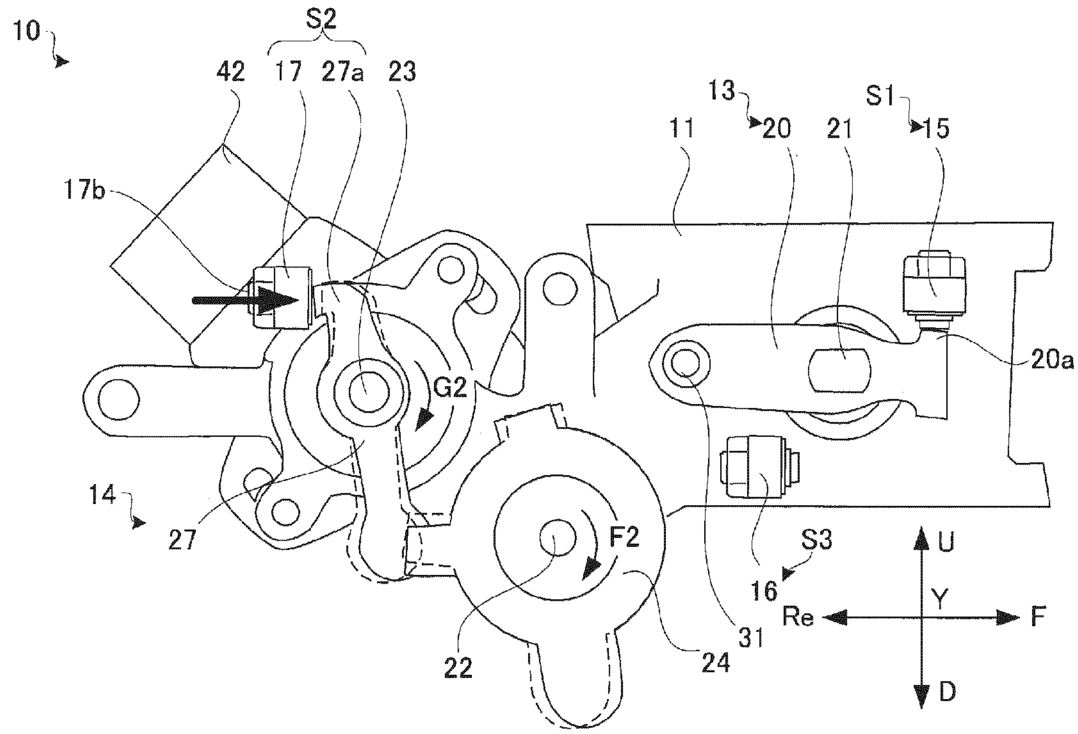
27
F1
S3
U
16
Y
Re
F
31
22
24
D

Fig. 9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27a
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S1
11
20
21
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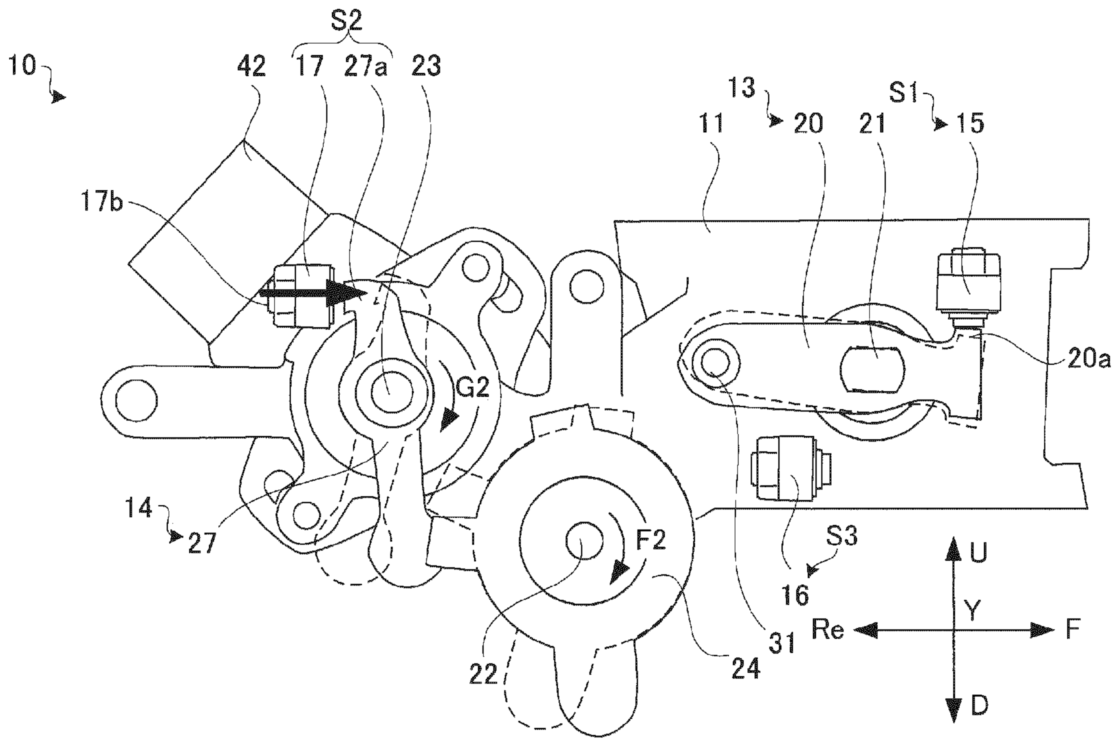
17b
20a
G2
14
27
F2
S3
U
16
Y
Re
F
31
22
24
D

Fig. 10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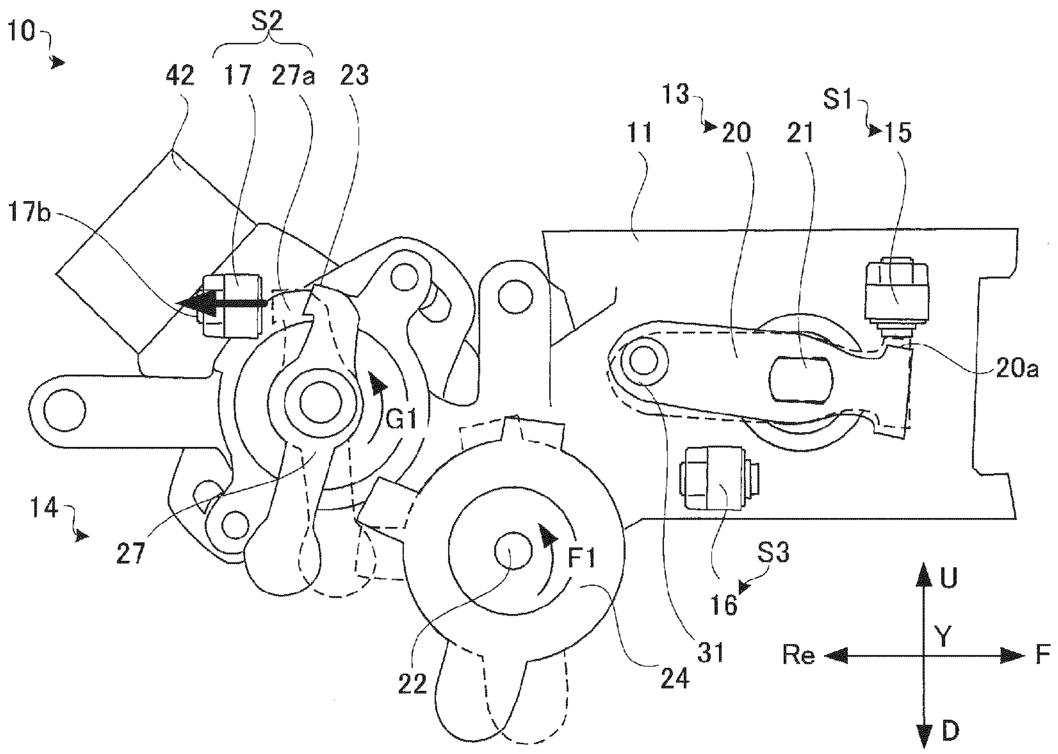
F2
S3
16
U
Y
Re
F
31
22
24
D

Fig. 11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G1
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F1
S3
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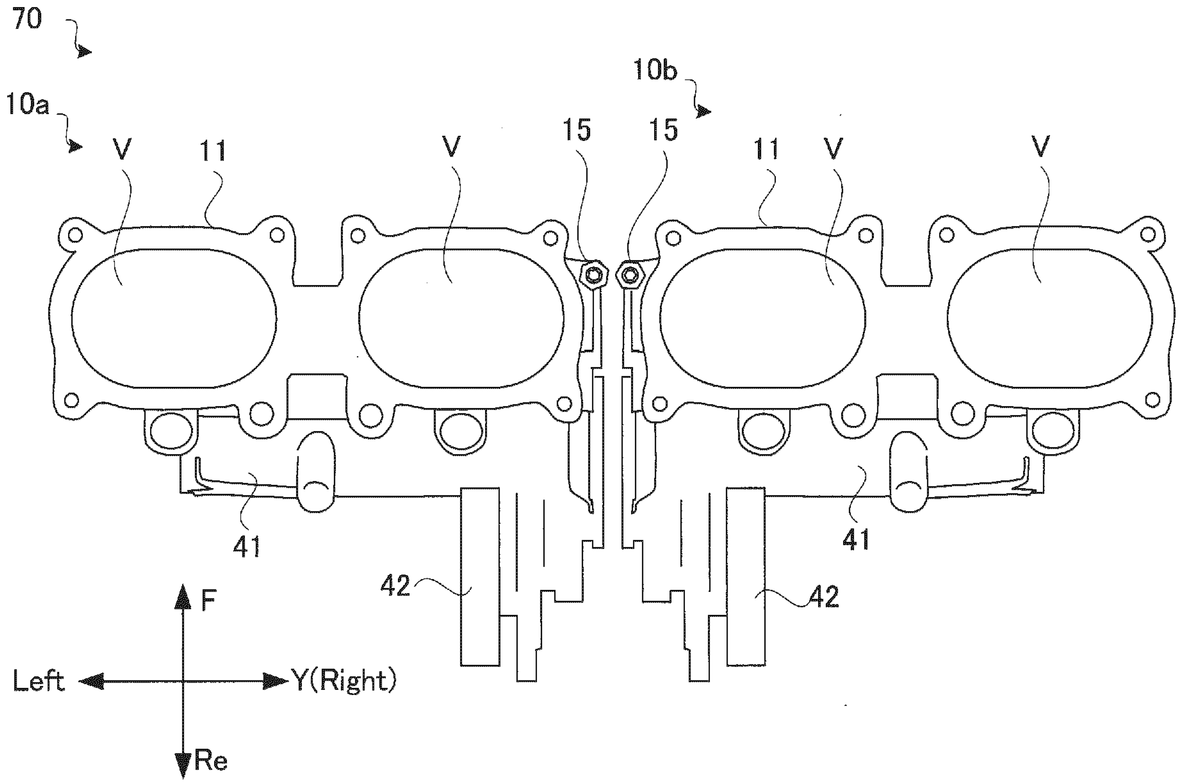
Y
Re
F
31
22
24
D

Fig. 12



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Application Number
EP 24 18 3273

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 October 2024	Boye, Michael

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