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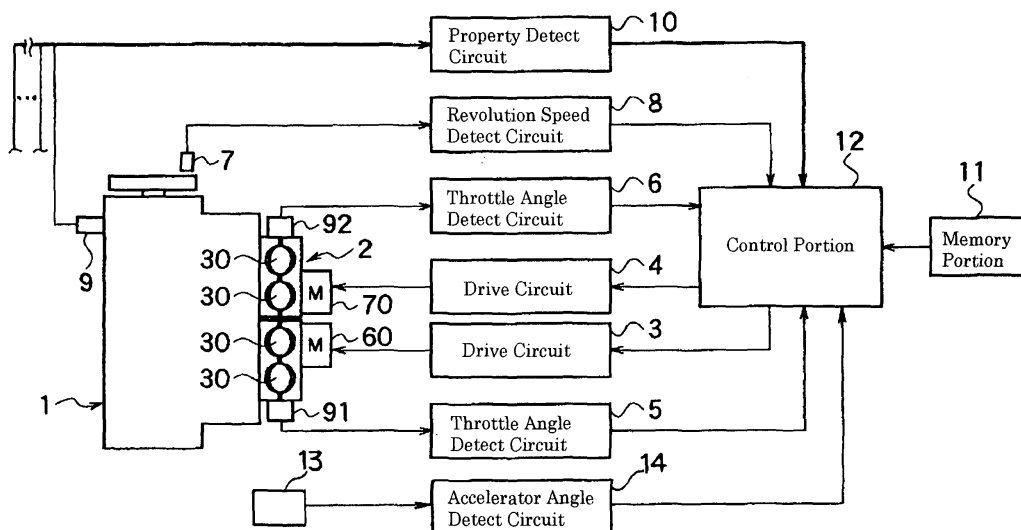
(54) **MULTIPLE THROTTLE DEVICE**

(57) The present apparatus comprises a plurality of throttle valves 30 respectively disposed at each air intake passage 21 corresponding to each cylinder of an engine, a plurality of throttle shafts 41, 42 to support the plurality of throttle valves 30 for each group, and a plurality of drive means 60, 70 to respectively drive the throttle shaft 41, 42. With this structure, open-close con-

trol of one group of the throttle valves and that of the other group can be performed separately. Therefore, the combustion condition, namely the power, can adequately be controlled in accordance with the driving conditions, and fine control, even to perform ISC, is possible.

In this manner, it becomes possible to obtain electronic control and fine control to a multiple throttle apparatus of an engine mounted on a motorcycle.

FIG.1



Description

TECHNICAL FIELD

[0001] The present invention relates to a multiple throttle apparatus to open and close a plurality of throttle valves which are disposed at the air intake passage of an engine. More particularly, it relates to a multiple throttle apparatus having a throttle valve at an air intake passage of each cylinder of an engine which is mounted on a motorcycle etc.

BACKGROUND ART

[0002] As a conventional throttle apparatus mounted on a four-wheel car, an electronically controlled throttle apparatus or a wire-operated and electronically controlled throttle apparatus are known.

[0003] For example, the structure of a wire-operated and electronically controlled throttle apparatus is disclosed in Japanese Patent Laid-open H6-207535 as follows. With the air intake unit for a six-cylinder V-type engine comprising two surge tanks which collect the air intake passages provided for each cylinder three each and air intake passages extending upstream from each surge tank, two throttle valves disposed at each upstream air intake passage are linked with a single throttle shaft and driven by a single wire to open and close. Then, when traction control is performed, the throttle valves are driven by a single motor to the closing direction.

[0004] For another example, a throttle apparatus, with throttle valves each respectively disposed to two air intake passages which are formed in a throttle body and linked free to pivot with a throttle shaft and driven to open and close by a motor which is disposed at an end side of the throttle shaft, is disclosed in Japanese Patent Laid-open H8-218904.

[0005] With the abovementioned apparatus, since the conventional throttle apparatus is disposed at the upstream side of a surge tank or the upstream side of a relatively long air intake passage, the air controlled by open and close operation of the throttle valve flows into an air intake passage (an air intake port) corresponding to each cylinder after being stored in a surge tank or after passing through a long intake passage. Therefore, air amount flowing into an engine cylinder does not change much in accordance with a small open and close movement of the throttle valve. Accordingly, fine open and close control is not effective.

[0006] On the other hand, as a throttle apparatus which is mounted on a motorcycle etc, a multiple throttle apparatus is known because the responsibility of throttle operation is considered important. With this apparatus, a throttle valve is disposed to each air intake passage corresponding to each cylinder (each air intake port) at the position close to the air intake port of a cylinder head. Each throttle shaft supporting each throttle valve free to

pivot is linked together with synchronize levers, urge springs, and so on to transmit torque, and all throttle valves are driven to open and close by a single wire. Further, to perform idle speed control (ISC) of the engine, a separate ISC valve is disposed to this apparatus.

[0007] By the way, even for an engine mounted to a motorcycle etc, electronically control which drives a plurality of throttle valves with a motor is contemplated. Further, it is also contemplated to eliminate a separate ISC valve by controlling idle speed with fine adjustment of the opening angle of the throttle valve.

[0008] Further, throttle operation of a motorcycle is more sensitive than that of a four-wheel car and is accompanied with rapid changes. Therefore, it is desired to ensure safe driving without rapid drive operation etc. by controlling power at adequate conditions while improving performance, even in a situation when the driver mishandles the throttle or when the road conditions etc. are poor.

[0009] The present invention was devised in view of the abovementioned circumstances of the related art. The object of the present invention is to provide a multiple throttle apparatus which is suitable for a high performance engine especially engines mounted on motorcycles etc. Namely, to open and close a plurality of throttle valves disposed at each air intake passage respectively by a motor, the power is adequately controlled in accordance with the driving conditions etc. while achieving excellent drivability and safe driving.

DISCLOSURE OF THE INVENTION

[0010] The multiple throttle apparatus of the present invention comprises a plurality of throttle valves respectively disposed at each air intake passage corresponding to each cylinder of an engine, a throttle shaft supporting to open and close the plurality of throttle valves, and a drive means including a motor to rotate the throttle shaft, wherein the plurality of throttle valves are separated into a plurality of groups, the throttle shaft includes a plurality of throttle shafts supporting the throttle valves for each group, and the drive means includes a plurality of drive means exerting drive force to each throttle shaft.

[0011] With this structure, the throttle valves are separated into groups and respectively controlled to open and close by each drive apparatus. Therefore, the combustion condition namely the power can be adequately controlled in accordance with the driving conditions, and similar control can be possible even to perform ISC.

[0012] In the abovementioned structure, it is possible that the plurality of throttle shafts include a first throttle shaft and a second throttle shaft which are disposed in a line, and the drive means includes a first drive means exerting drive force to the first throttle shaft and a second drive means exerting drive force to the second throttle shaft.

[0013] With this structure, the multiple throttle apparatus can be adopted to a straight engine which cylin-

ders are disposed in a line. The first throttle shaft supporting a throttle valve or more (for example, two, three etc.) is driven by the first drive means. The second throttle shaft supporting a throttle valve or more (for example, two, three etc.) is driven by the second drive means.

[0014] In the abovementioned structure, it is possible that the first drive means and the second drive means are disposed to exert drive force to the inner end portion of the side where the first throttle shaft and the second throttle shaft face each other.

[0015] With this structure, the first drive means and the second drive means are aggregated around the center range of the apparatus, and the apparatus becomes compact in width and size.

[0016] In the abovementioned structure, it is possible that the plurality of throttle shafts include a first throttle shaft and a second throttle shaft which are disposed in parallel, and the drive means includes a first drive means to exert drive force to the first throttle shaft and a second drive means to exert drive force to the second throttle shaft.

[0017] With this structure, the multiple throttle apparatus can be adopted to a V-type engine which cylinders are disposed in V-shape. The first throttle shaft supporting a throttle valve or more (for example, two, three etc.) is driven by the first drive means. The second throttle shaft supporting a throttle valve or more (for example, two, three etc.) is driven by the second drive means.

[0018] In the abovementioned structure, it is possible that the first drive means is disposed to exert drive force to an end portion of the first throttle body at one end side of the first throttle shaft and the second throttle shaft, and the second drive means is disposed to exert drive force to an end portion of the second throttle shaft at the other end side of the first throttle shaft and the second throttle shaft.

[0019] With this structure, the first drive means and the second drive means are disposed in good balance at both sides, and the entire apparatus becomes compact in width and size.

[0020] In the abovementioned structure, it is possible that the motor of the first drive means and the motor of the second drive means are disposed in the space between the first throttle shaft and the second throttle shaft.

[0021] With this structure, the first drive means and the second drive means are aggregated in the space sandwiched by two throttle shafts, namely throttle bodies. Therefore, the apparatus becomes further compact in width and size.

[0022] In the abovementioned structure, it is possible that the plurality of drive means is separately controlled in accordance with the driving conditions of an engine.

[0023] With this structure, when two drive means are disposed for example, it is possible that one drive means is controlled based on the accelerator operation, and the other drive means is controlled in accordance with control signals which are determined based on the driving

conditions and the accelerator operation. It is also possible that only one drive means is controlled for idle-speed-up (fast-idle). Further, it is also possible to control the drive means completely separately by respective computer exclusively prepared for each drive means. Therefore, starting, controllability, specific fuel consumption, safety, etc. of the engine can be improved.

[0024] In the abovementioned structure, it is possible that the plurality of throttle shafts include a first throttle shaft and a second throttle shaft which are disposed in parallel, and the plurality of drive means include a first drive means being controlled to exert drive force to the first throttle shaft and a second drive means being controlled to exert drive force to the second throttle shaft.

[0025] With this structure, with a V-type engine which cylinders are disposed in V-shape, it is also possible that the first drive means is controlled to exert drive force to the throttle shaft disposed at the front-bank of the front wheel side of the vehicle, and the second drive means is controlled to exert drive force to the throttle shaft disposed at the rear-bank of the rear wheel side of the vehicle, for example. In this case, supplying adequate air amount for each cylinder group which combustion characteristic differs from each other is possible.

[0026] In the abovementioned structure, it is possible that the plurality of drive means control to open and close at least one group of the throttle valves, and after a specific time, control to open and close the rest of the group of the throttle valves consequently.

[0027] With this structure, since it is possible to suppress rapid revolution speed change of the engine even when the throttle is returned quickly, safe driving is ensured.

[0028] In the abovementioned structure, it is possible that the plurality of drive means control at least one group of the throttle valves out of the plurality of groups at a specific angle in accordance with the driving conditions of an engine.

[0029] Here, the throttle valves of one group are kept constant while the throttle valves of the other group are controlled to open and close. Consequently, one group and the other group are controlled separately. Therefore, by controlling to open and close the throttle valves for each group, adequate air amount can be supplied according to the combustion conditions of the engine which differ for each cylinder.

[0030] In the abovementioned structure, it is possible that the specific angle is the angle to which the throttle valve is controlled while revolution speed of an engine is low.

[0031] With this structure, it is possible to operate only one drive means to perform fine adjustment of the throttle opening when the engine speed is low. In this manner, it is possible to select adequate angle of the throttle valve in accordance with the driving conditions.

BRIEF DISCRIPTION OF THE DRAWINGS

[0032] Fig. 1 is a block diagram showing a control system utilizing a multiple throttle apparatus of the present invention.

[0033] Fig. 2 is an abbreviated schematic drawing showing an embodiment of a multiple throttle apparatus of the present invention.

[0034] Fig. 3 is a side view showing a drive means of the apparatus shown in Fig. 1.

[0035] Fig. 4 is an abbreviated schematic drawing showing another embodiment of a multiple throttle apparatus of the present invention.

[0036] Fig. 5 is a side view showing a drive means of the apparatus shown in Fig. 4.

[0037] Fig. 6 is plain sectional view of the apparatus shown in Fig. 4.

BEST MODE FOR CARRYING OUT THE INVENTION

[0038] The embodiments of the present invention are explained in the following with reference to the attached drawings.

[0039] Fig. 1 through 3 show an embodiment of a multiple throttle apparatus of the present invention. Fig. 1 is a block diagram showing a control system utilizing the apparatus to an engine mounted on a motorcycle. Fig. 2 is a sectional view of the apparatus. Fig. 3 is a side view showing a drive means of the apparatus.

[0040] As shown in Fig. 1, the control system comprises an engine 1, a multiple throttle apparatus 2 mounted on an air intake system of the engine 1, drive circuits 3, 4 to respectively drive two drive means 60, 70 disposed at the apparatus 2, an angle detect sensor 91, 92 and an throttle angle detect circuit 5, 6 to detect the angle position of a throttle valve, a revolution sensor 7 and a revolution speed detect circuit 8 to detect revolution speed of the engine 1, a sensor 9 (a water temperature sensor is shown in the figure) and a property detect circuit 10 to detect another property of the engine 1 (such as water temperature, intake air temperature, intake air pressure of the engine 1, and atmospheric pressure around the engine 1), a memory portion 11 having various control information and drive maps etc. stored in advance, a control portion 12 to control all the system, an accelerator angle sensor 13 and an accelerator angle detect circuit 14 to detect the rotate angle position of an accelerator (a grip) which is operated by a driver, and so on.

[0041] The apparatus 2 is a four-barrel throttle apparatus which is utilized for a straight four cylinder engine. As shown in Fig. 2, the apparatus 2 comprises four throttle bodies 20 to form air intake passages 21, four throttle valves 30 disposed respectively to each intake passage 21, a first throttle shaft 41 and a second throttle shaft 42, bearings 50, a first drive means 60 and a second drive means 70, a first return spring 81 and a second return spring 82, a first angle detect sensor 91 and a

second angle detect sensor 92, a connect bolt 100, and so on.

[0042] The throttle body 20 is molded of aluminum material or resin material. As shown in Fig. 2, the throttle body 20 has an air intake passage 21 which section is approximately circular, a through-hole 22 through which the throttle shaft 41, 42 passes, a concave fit portion 23 to which the bearing 50 fits, a joint surface 24, a bolt hole 25 through which the connect bolt 100 passes, and so on. The through hole 22 is formed to be slightly larger than the diameter of the first throttle shaft 41 and that of the second throttle shaft 42 to prevent any contact.

[0043] As shown in Fig. 2, the first throttle shaft 41 and the second throttle shaft 42 are arranged in a line. Then, the first throttle shaft 41 rotatably supports to simultaneously open and close the two throttle valves 30 of the left side which is the first group. The second throttle shaft 42 rotatably supports to simultaneously open and close the two throttle valves 30 of the right side which is the second group.

[0044] The bearing 50 is disposed at both sides to sandwich each throttle valve 30. Therefore, the throttle shafts 41, 42 rotate smoothly without twisting etc, and the synchronization (open and close operation at the same phase) of the throttle valves between the groups is ensured. Here, for the bearing 50, it is possible to adopt various types of bearing, such as a ball bearing, a roller bearing, a bush bearing which the contact face itself functions as a bearing, and so on. Further, at least a part of the plurality of bearings 50 supports not only in the radial direction but also in the thrust direction.

[0045] As shown in Fig. 2 and Fig. 3, the first drive means 60 has a DC motor 61, a gear 62 fixed to an output shaft 61a, a gear 63 fixed at an inner end portion of the first throttle shaft 41 and meshed with the gear 62, and an adjust screw 64 to adjust the stop position of the gear 63.

[0046] The first return spring 81 is disposed at the vicinity of the gear 63, and urges the first throttle shaft 41 in the rotating direction to return the two throttle valves 30 of the first group toward the rest position of the closing side.

[0047] When the DC motor 61 rotates from the rest state, the first throttle shaft 41 rotates via the gear 62 and the gear 63 against the urge force of the first return spring 81. Then, the two throttle valves 30 of the first group open the air intake passage 21. On the other hand, when the powering to the DC motor 61 is discontinued, the first throttle shaft 41 rotates in the opposite direction by the urging force of the first return spring 81, and the two throttle valves 30 of the first group return to the rest position of the closing side.

[0048] As shown in Fig. 2 and Fig. 3, the second drive means 70 has a DC motor 71, a gear 72 fixed to an output shaft 71a, a gear 73 fixed at an inner end portion of the second throttle shaft 42 and meshed with the gear 72, and an adjust screw 74 to adjust the stop position of the gear 73.

[0049] The second return spring 82 is disposed at the vicinity of the gear 73, and urges the second throttle shaft 42 in the rotating direction to return the two throttle valves 30 of the second group toward the rest position of the closing side.

[0050] When the DC motor 71 rotates from the rest state, the second throttle shaft 42 rotates via the gear 72 and the gear 73 against the urge force of the second return spring 82. Then, the two throttle valves 30 of the second group open the air intake passage 21. On the other hand, when the powering to the DC motor 71 is discontinued, the second throttle shaft 42 rotates in the opposite direction by the urging force of the second return spring 82, and the two throttle valves 30 of the second group return to the rest position of the closing side.

[0051] As mentioned above, the first drive means 60 and the second drive means 70 include a gear train, and are disposed to exert drive force to the inner end portions where the first throttle shaft 41 and the second throttle shaft 42 face each other. Therefore, these parts are aggregated around the center range, and the apparatus 2 becomes compact in width and size.

[0052] As shown in Fig. 2, the first angle detect sensor 91 and the second angle detect sensor 92 are non-contact type sensors disposed at each outer end portion of the first throttle shaft 41 and the second throttle shaft 42. The sensors detect the rotate angle position of the throttle shafts 41, 42, namely the rotate angle position of the throttle valves 30 of the first group and the rotate angle position of the throttle valves 30 of the second group, and output the detect signals to the control portion 12 via the angle detect circuit 5, 6.

[0053] Next, the working of the abovementioned multiple throttle apparatus is explained.

[0054] In normal drive mode, the DC motors 61, 71 rotate in one direction in accordance with the control signal from the control portion 12. The rotate drive force is transmitted to the first throttle shaft 41 and the second throttle shaft 42 via the gear 62, 63 and the gear 72, 73. Then, the first throttle shaft 41 and the second throttle shaft 42 start to rotate in one direction. The throttle valves 30 of the first group and the second group rotate from the rest position in the direction to open the air intake passage 21.

[0055] On the contrary, when the DC motors rotate in the opposite direction based on the control signal from the control portion 12, the first throttle shaft 41 and the second throttle shaft 42 also rotate in the opposite direction while receiving the urging force of the return spring 81, 82. Then the throttle valves 30 of the first group and the second group rotate from the full-open position in the direction to close the air intake passage 21. Here, when the powering to the DC motors 61, 71 is discontinued, the first throttle shaft 41 and the second throttle shaft 42 quickly rotate by the urging force of the return spring 81, 82, and return the throttle valves 30 of the first group and the second group to the rest position.

[0056] Consequently, in a normal drive mode, DC mo-

tors 61, 71 are simultaneously controlled in accordance with the driving conditions etc. That is, the throttle valves 30 of the first group and the second group are simultaneously controlled to be at an adequate opening in accordance with the signal of the accelerator angle sensor 13.

[0057] In a mode other than the normal drive mode, when air amount to all cylinders of an engine is simultaneously controlled by the throttle valves, tiny changes in the throttle valve angle cause large increase of air amount provided to the engine. Therefore, it is difficult to provide adequate air amount unless the small angle of the throttle valves is precisely controlled. For this reason, the air amount to all cylinders is not simultaneously controlled by the same throttle valves. For, example, one DC motor 61 is controlled to keep the two throttle valves 30 of the left side which belong to the first group at a constant opening, and the other DC motor 71 is controlled to open and close the throttle valves 30 of the right side which belong to the second group. Namely, the air amount is adjusted by the throttle valves of each group. In this case, since the opening of the throttle valves of one group is previously kept constant, the sensitivity of the increase of the air amount to the engine can be suppressed and adequate air amount can be provided, compared with the case that the air amount to all cylinders of the engine is controlled simultaneously with the same valves. As a result, cost can be suppressed because the performance of the A/D converter and the angle sensor does not necessarily have to be high.

[0058] In addition, the combustion condition of each cylinder of an engine differs from each other due to the cooling conditions of the engine and the difference of the length of the exhaust pipes. Therefore, when one DC motor 61 is controlled to keep the two throttle valves 30 of the left side which belong to the first group at a constant opening, and the other DC motor 71 is controlled to open and close the throttle valves of the right side which belong to the second group, adequate air amount can be supplied to each cylinder which has different combustion characteristics in accordance with the combustion condition.

[0059] Further, when the opening of the throttle valves 30 of the first group and the second group is at maximum, and the vehicle quickly accelerates, the driver etc. may have a possibility of not being able to drive safely due to quick torque increase phenomenon. In such a case, one DC motor 61 is controlled to keep the opening of the throttle valves 30 of the left side which is the first group at the opening before the acceleration, and the other DC motor 71 is controlled to open and close the throttle valves 30 of the right side which is the second group in accordance with the acceleration. In this case, since the air amount supplied to the engine is controlled for each group, the quick torque increase phenomenon is eased and the driver etc. can be ensured of safe driving without receiving influence of the quick acceleration.

[0060] Meanwhile, in an idle operation condition, only the DC motor 61, for example, is adequately controlled based on the drive signal from the control portion 12. In this case, fine adjustment of the first throttle shaft 41, namely the opening of the throttle valves 30 of the first group, is performed.

[0061] To perform ISC of an engine without having a separate ISC valve by adjusting all cylinders simultaneously with the same throttle valves, extremely fine adjustment of the valve opening is needed to follow the target of idle revolution speed changes. In this case, the performance of the A/D converter and the angle sensor has to be high. Here, as mentioned above, one DC motor 61 is controlled to keep the two throttle valves 30 of the left side as the first group at a constant opening, and the other DC motor 71 is controlled to open and close the throttle valves 30 of the right side as the second group. In this case, since the opening of the throttle valves of one group is previously kept constant, compared to the case of adjusting by the same throttle valves, it is easier to supply adequate air amount in accordance with the target of idle revolution speed changes without fine-adjusting of the valve opening. Then, cost reduction can be achieved because the performance of the A/D converter and the angle sensor does not necessarily have to be high. In this manner, even in the case performing ISC, controlling to open and close the throttle valves 30 by each group is made possible.

[0062] Further, when rapid returning of the throttle is performed, for example, after one of the DC motors 61, 71 is driven in the opposite direction, the other is driven in the opposite direction based on the drive signal of the control portion 12. Namely, after the throttle valves 30 of one group close, the throttle valves 30 of the other group close sequentially. In this manner, by driving the throttle valves 30 for each group with time difference, rapid revolution change of the engine 1 is suppressed, and safe driving can be ensured while preventing nose-dive, slip, overturning etc.

[0063] On the contrary, when the vehicle quickly accelerates, after one of the DC motors 61, 71 is driven, the other is driven based on the control signal of the control portion 12. Namely, after the throttle valves 30 of one group open, the throttle valves 30 of the other group open sequentially. In this manner, other than controlling the opening of one group constantly, by driving the throttle valves 30 for each group with time difference, rapid revolution change of the engine 1 is suppressed, and the driver etc. can be ensured of safe driving without having influence of the quick acceleration.

[0064] Fig. 4 through 6 show another embodiment of a multiple throttle apparatus of the present invention. Here, the control system is the same as shown in Fig. 1.

[0065] The apparatus 110 is a four-barrel throttle apparatus which is utilized for a V-type four cylinder engine. As shown in Fig. 4 and Fig. 6, the apparatus 110 comprises four throttle bodies 120 to form air intake passages 121, four throttle valves 130 disposed respectively

ly to each intake passage 121, a first throttle shaft 141 and a second throttle shaft 142, bearings 50 which is the same as mentioned before, a first drive means 160 and a second drive means 170, a first return spring 181 and a second return spring 182, a first angle detect sensor 191 and a second angle detect sensor 192, a spacer 200, a connect plate 210, and so on.

[0066] The throttle body 120 is molded of aluminum material or resin material. As shown in Fig. 4 and Fig. 6, the throttle body 120 has the air intake passage 121 which section is approximately circular, a through-hole 122 through which the throttle shaft 141, 142 passes, a concave fit portion 123 to which the bearing 50 fits, a joint convex portion 124, and so on. The through hole 122 is formed to be slightly larger than the diameter of the first throttle shaft 141 and that of the second throttle shaft 142 to prevent any contact.

[0067] Further, two throttle bodies 120 of the left side and two throttle bodies 120 of the right side are respectively connected via the spacer 200. Then, the connect plate 210 connects the entire apparatus firmly. Here, the spacer 200 has a through-path 201 and a fit concave portion 202, as shown in Fig. 6.

[0068] As shown in Fig. 4 and Fig. 6, the first throttle shaft 141 and the second throttle shaft 142 are disposed in parallel with a specific space. Then, the first throttle shaft 141 rotatably supports to simultaneously open and close the two throttle valves 130 of the left side as the first group. The second throttle shaft 142 rotatably supports to simultaneously open and close the two throttle valves 130 of the right side as the second group.

[0069] Further, like a straight four cylinder engine, with a V-type engine, the combustion characteristic differs from each other depending on a bank, a cylinder, cooling conditions of the engine, and the length of the exhaust pipe. Therefore, for example, the first drive means 160 is to be controlled to exert drive force to the first throttle shaft 141 which is disposed at the front-bank of the front wheel side of the vehicle. Then, the second drive means 170 is to be controlled to exert drive force to the second throttle shaft 142 which is disposed at the rear-bank of the rear wheel side of the vehicle. In this manner, by driving each throttle shaft separately, it is possible to supply adequate air amount to each cylinder group which has different combustion characteristics.

[0070] As shown in Fig. 4 through 6, the first drive means 160 is disposed at one end side of the first throttle shaft 141 and the second throttle shaft 142 (one end side of the apparatus 110). The first drive means 160 has a DC motor 161, a pinion 161a fixed to an output shaft, a gear 162 (a large gear 162a, a small gear 162b), a gear 163 fixed to an end portion of the first throttle shaft 141 and meshed with the gear 162 (the small gear 162b), and an adjust screw 164 to adjust the stop position of the gear 163.

[0071] The DC motor 161 is disposed between the first throttle shaft 141 and the second throttle shaft 142, namely at the space sandwiched by the throttle bodies

120 of the left side and the right side.

[0072] The first return spring 181 is disposed approximately at the center of the first throttle shaft 141, and urges the first throttle shaft 141 in the rotating direction to return the two throttle valves 130 of the first group toward the rest position of the closing side.

[0073] When the DC motor 161 rotates from the rest state, the first throttle shaft 141 rotates via the gear 162 and the gear 163 against the urge force of the first return spring 181. Then, the two throttle valves 130 of the first group rotate in the direction to open the air intake passage 121. On the other hand, when the powering to the DC motor 161 is discontinued, the first throttle shaft 141 rotates in the opposite direction by the urging force of the first return spring 181, and the two throttle valves 130 of the first group return to the rest position of the closing side.

[0074] As shown in Fig. 4 through 6, the second drive means 170 is disposed at the other end side of the first throttle shaft 141 and the second throttle shaft 142 (the other end side of the apparatus 110). The second drive means 170 has a DC motor 171, a pinion 171a fixed to an output shaft, a gear 172 (a large gear 172a, a small gear 172b), a gear 173 fixed to an end portion of the second throttle shaft 142 and meshed with the gear 172 (the small gear 172b), and an adjust screw 174 to adjust the stop position of the gear 173.

[0075] The DC motor 171 is disposed between the first throttle shaft 141 and the second throttle shaft 142, namely at the space sandwiched by the throttle bodies 120 of the left side and the right side.

[0076] The second return spring 182 is disposed approximately at the center of the second throttle shaft 142, and urges the second throttle shaft 142 in the rotating direction to return the two throttle valves 130 of the second group toward the rest position of the closing side.

[0077] When the DC motor 171 rotates from the rest state, the second throttle shaft 142 rotates via the gear 172 and the gear 173 against the urge force of the second return spring 182. Then, the two throttle valves 130 of the second group rotate in the direction to open the air intake passage 121. On the other hand, when the powering to the DC motor 171 is discontinued, the second throttle shaft 142 rotates in the opposite direction by the urging force of the second return spring 182, and the two throttle valves 130 of the second group return to the rest position of the closing side.

[0078] As mentioned above, the first drive means 160 and the second drive means 170 include a gear train, and are disposed in good balance at both sides of the first throttle shaft 141 and the second throttle shaft 142. Therefore, the apparatus 110 becomes compact in width and size. Furthermore, since the DC motors 161, 171 are disposed at the space sandwiched by the throttle bodies 120, the parts are aggregated around the center range, and the apparatus 110 is downsized further.

[0079] As shown in Fig. 4 and Fig. 6, the first angle detect sensor 191 and the second angle detect sensor 192 are non-contact type sensors disposed at each other end portion of the first throttle shaft 141 and the second throttle shaft 142. The sensors detect the rotate angle position of the throttle shafts 141, 142, namely the rotate angle position of the throttle valves 130 of the first group and the rotate angle position of the throttle valves 130 of the second group, and output the detect signals to the control portion 12 via the angle detect circuit 5, 6 which is mentioned before.

[0080] Here, the control working of the apparatus 110 is the same as the abovementioned embodiment. Therefore, explanation is omitted.

[0081] In the abovementioned embodiment, a four-barrel throttle apparatus is shown as the multiple throttle apparatus. However, not limited to this, a multiple throttle apparatus such as two-barrel, three-barrel, five-barrel or more can adopt the structure of the present invention.

[0082] Further, in the abovementioned embodiment, a structure including a gear train is shown as the drive means. However, not limited to this, it is also possible to adopt other drive means such as chain driving, belt driving and so on.

[0083] Furthermore, in the abovementioned embodiment, an engine mounted on a motorcycle is shown as an engine to utilize a multiple throttle apparatus of the present invention. However, not limited to this, a high performance engine mounted on an automobile or other vehicle is also possible to adopt a multiple throttle apparatus of the present invention.

INDUSTRIAL APPLICABILITY

[0084] As mentioned above, with the multiple throttle apparatus of the present invention, a plurality of throttle valves which are respectively disposed at each air intake passage corresponding to each cylinder of an engine are supported by a plurality of throttle shafts by separating the throttle valves into groups, and a plurality of drive means are disposed to respectively drive the plurality of throttle shafts. In this manner, the throttle valves can be driven to open and close by each group. In addition, by controlling the plurality of drive means separately, the combustion condition, namely the power, can adequately be controlled in accordance with the driving conditions.

Claims

1. A multiple throttle apparatus, comprising:

a plurality of throttle valves respectively disposed at each air intake passage corresponding to each cylinder of an engine,
a throttle shaft supporting to open and close

said plurality of throttle valves, and
a drive means including a motor to rotate said
throttle shaft,

wherein said plurality of throttle valves are
separated into a plurality of groups, 5

wherein said throttle shaft includes a plurality
of throttle shafts supporting said throttle valves for
each group, and

wherein said drive means includes a plurality
of drive means exerting drive force to each throttle
shaft. 10

2. The multiple throttle apparatus according to claim
1, wherein said plurality of throttle shafts include a
first throttle shaft and a second throttle shaft which
are disposed in a line, and said drive means in-
cludes a first drive means exerting drive force to
said first throttle shaft and a second drive means
exerting drive force to said second throttle shaft. 20

3. The multiple throttle apparatus according to claim
2, wherein said first drive means and said second
drive means are disposed to exert drive force to the
inner end portion of the side where said first throttle
shaft and said second throttle shaft face each other. 25

4. The multiple throttle apparatus according to claim
1, wherein said plurality of throttle shafts include a
first throttle shaft and a second throttle shaft which
are disposed in parallel, and said drive means in-
cludes a first drive means to exert drive force to said
first throttle shaft and a second drive means to exert
drive force to said second throttle shaft. 30

5. The multiple throttle apparatus according to claim
4, wherein said first drive means is disposed to exert
drive force to an end portion of said first throttle body
at one end side of said first throttle shaft and said
second throttle shaft, and said second drive means
is disposed to exert drive force to an end portion of
said second throttle shaft at the other end side of
said first throttle shaft and said second throttle shaft. 35

6. The multiple throttle apparatus according to claim 4
or claim 5, wherein said motor of said first drive
means and said motor of said second drive means
are disposed in the space between said first throttle
shaft and said second throttle shaft. 40

7. The multiple throttle apparatus according any one
of claims 1 through 6,
wherein said plurality of drive means is separately
controlled in accordance with the driving conditions
of an engine. 45

8. The multiple throttle apparatus according to claim
7, wherein said plurality of throttle shafts include a

first throttle shaft and a second throttle shaft which
are disposed in parallel, and said plurality of drive
means include a first drive means being controlled
to exert drive force to said first throttle shaft and a
second drive means being controlled to exert drive
force to said second throttle shaft.

9. The multiple throttle apparatus according to claim 7
or claim 8, wherein said plurality of drive means
control to open and close at least one group of the
throttle valves, and after a specific time, control to
open and close the rest of the group of the throttle
valves consequently.

10. The multiple throttle apparatus according to claim 7
or claim 8, wherein said plurality of drive means
control at least one group of the throttle valves out
of said plurality of groups at a specific angle in ac-
cordance with the driving conditions of an engine.

11. The multiple throttle apparatus according to claim
10, wherein said specific angle is the angle to which
the throttle valve is controlled while revolution
speed of an engine is low.

FIG.1

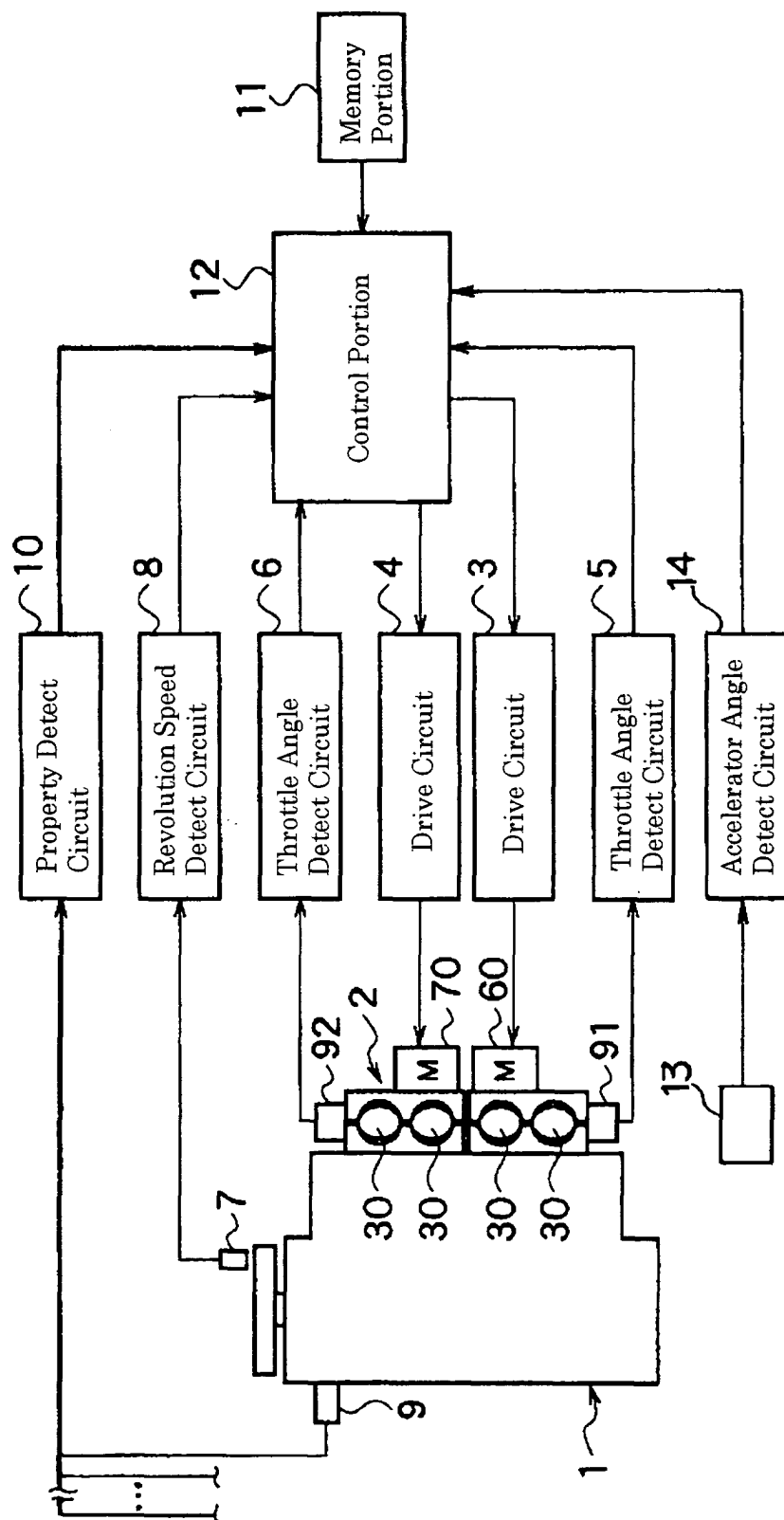


FIG. 2

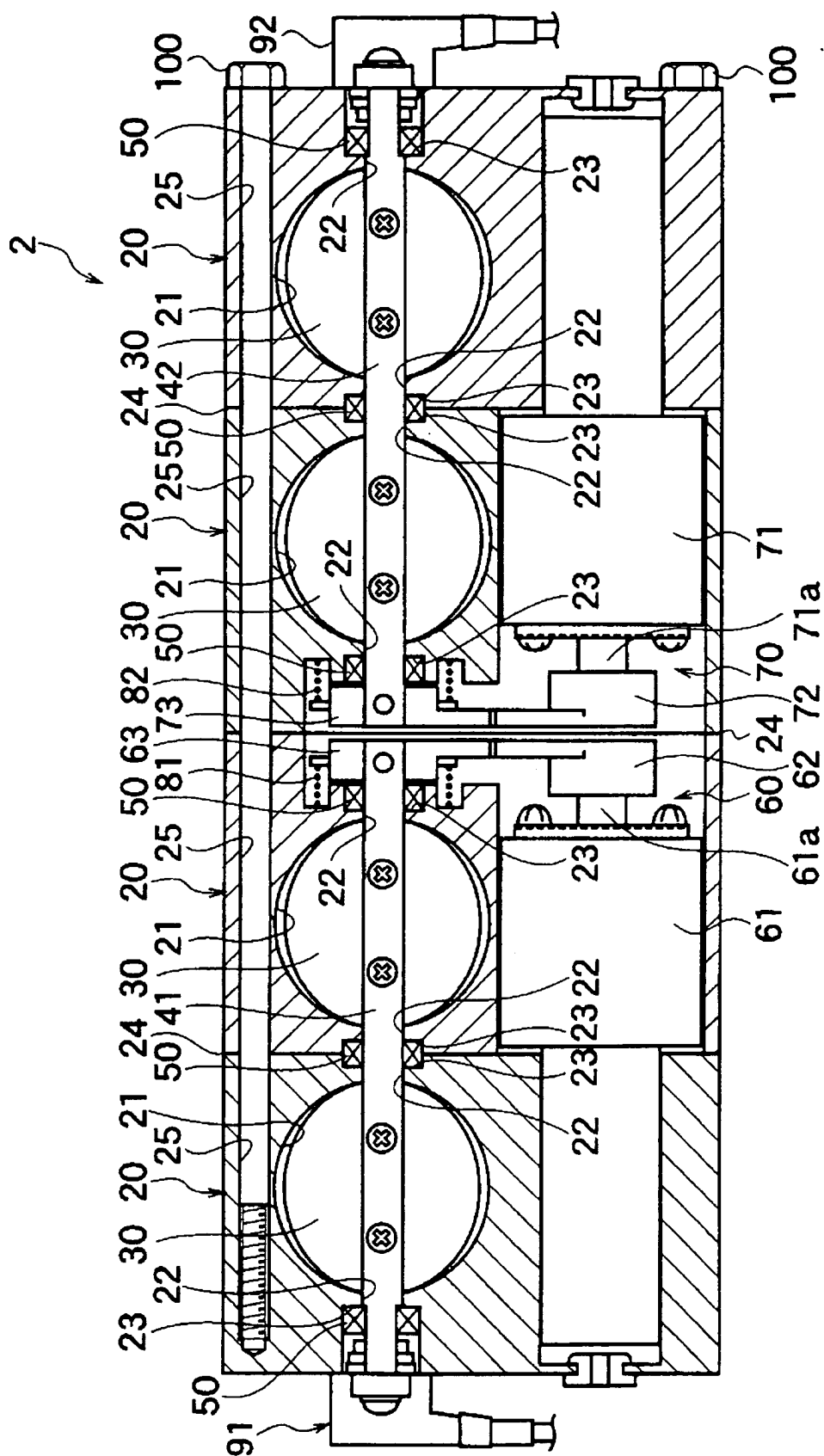


FIG.3

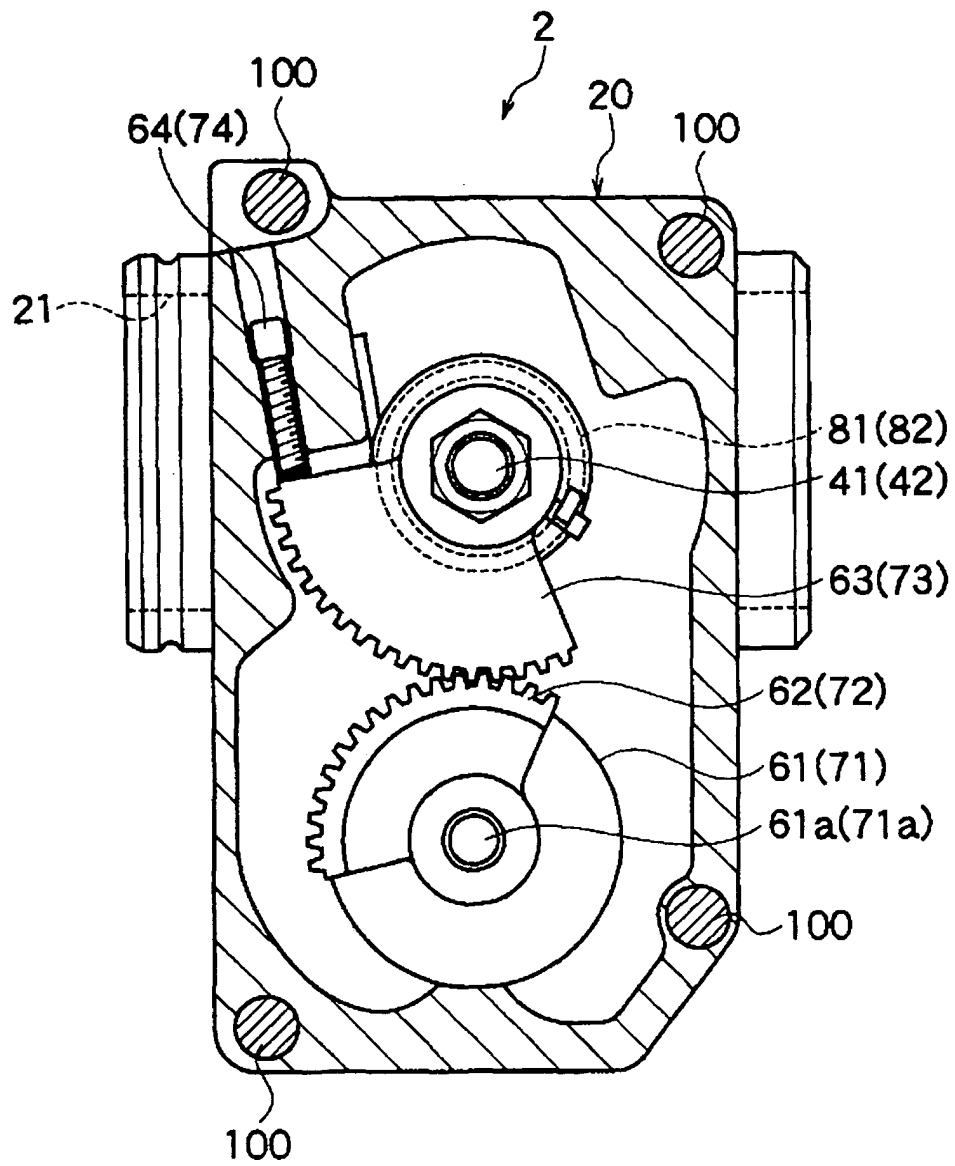


FIG.4

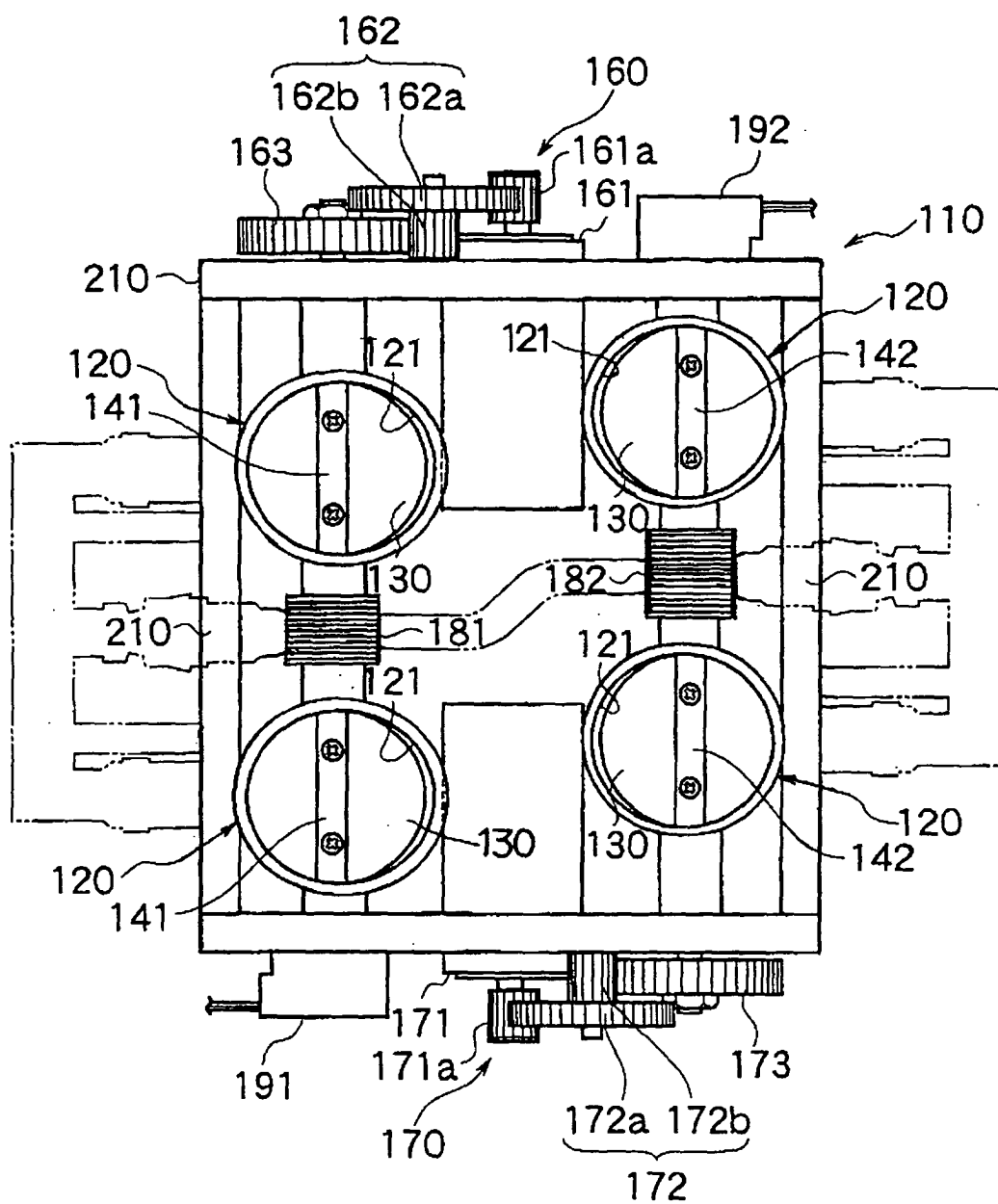


FIG.5

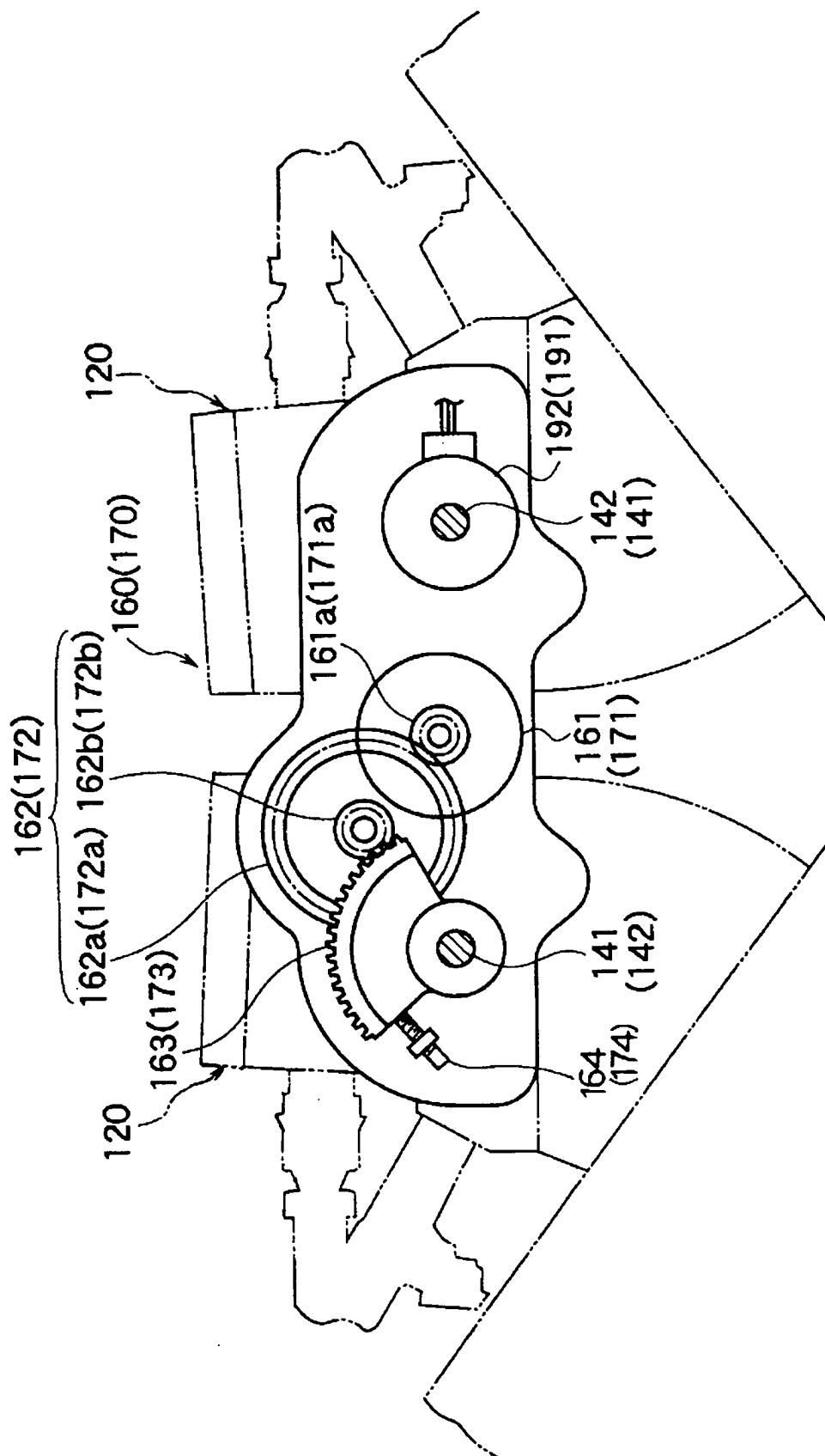
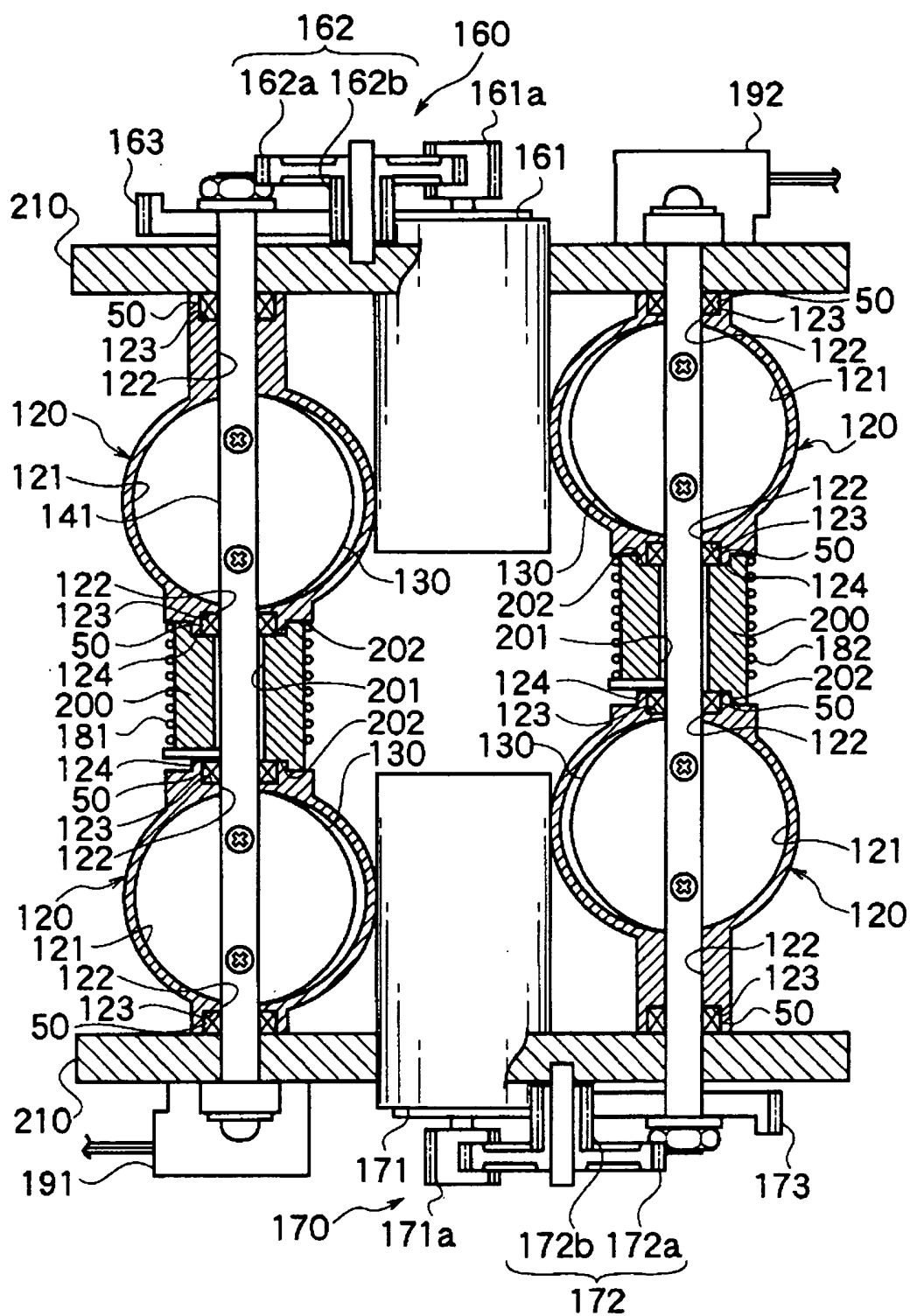


FIG.6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/11611

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl.⁷ F02D9/02

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl.⁷ F02D9/02Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1992-1996 Jitsuyo Shinan Toroku Koho 1996-2003
Kokai Jitsuyo Shinan Koho 1971-2003 Toroku Jitsuyo Shinan Koho 1994-2003

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	JP 2002-256896 A (Yamaha Motor Co., Ltd.), 11 September, 2002 (11.09.02), Par. Nos. [0047] to [0051]; Fig. 9 (Family: none)	1-3, 7
P, X P, Y	JP 2002-256900 A (Yamaha Motor Co., Ltd.), 11 September, 2002 (11.09.02), Par. Nos. [0050] to [0054]; Fig. 8 (Family: none)	1, 4-8 9-11
Y	JP 60-46254 B2 (Honda Motor Co., Ltd.), 15 October, 1985 (15.10.85), Page 1, right column, lines 14 to 19; page 3, left column, lines 6 to 39 (Family: none)	9

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

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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

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Date of the actual completion of the international search
06 October, 2003 (06.10.03)Date of mailing of the international search report
21 October, 2003 (21.10.03)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/11611

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-13493 A (Fuji Heavy Industries Ltd.), 19 January, 1999 (19.01.99), Claims 2, 12; Par. Nos. [0053], [0097] (Family: none)	10-11

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