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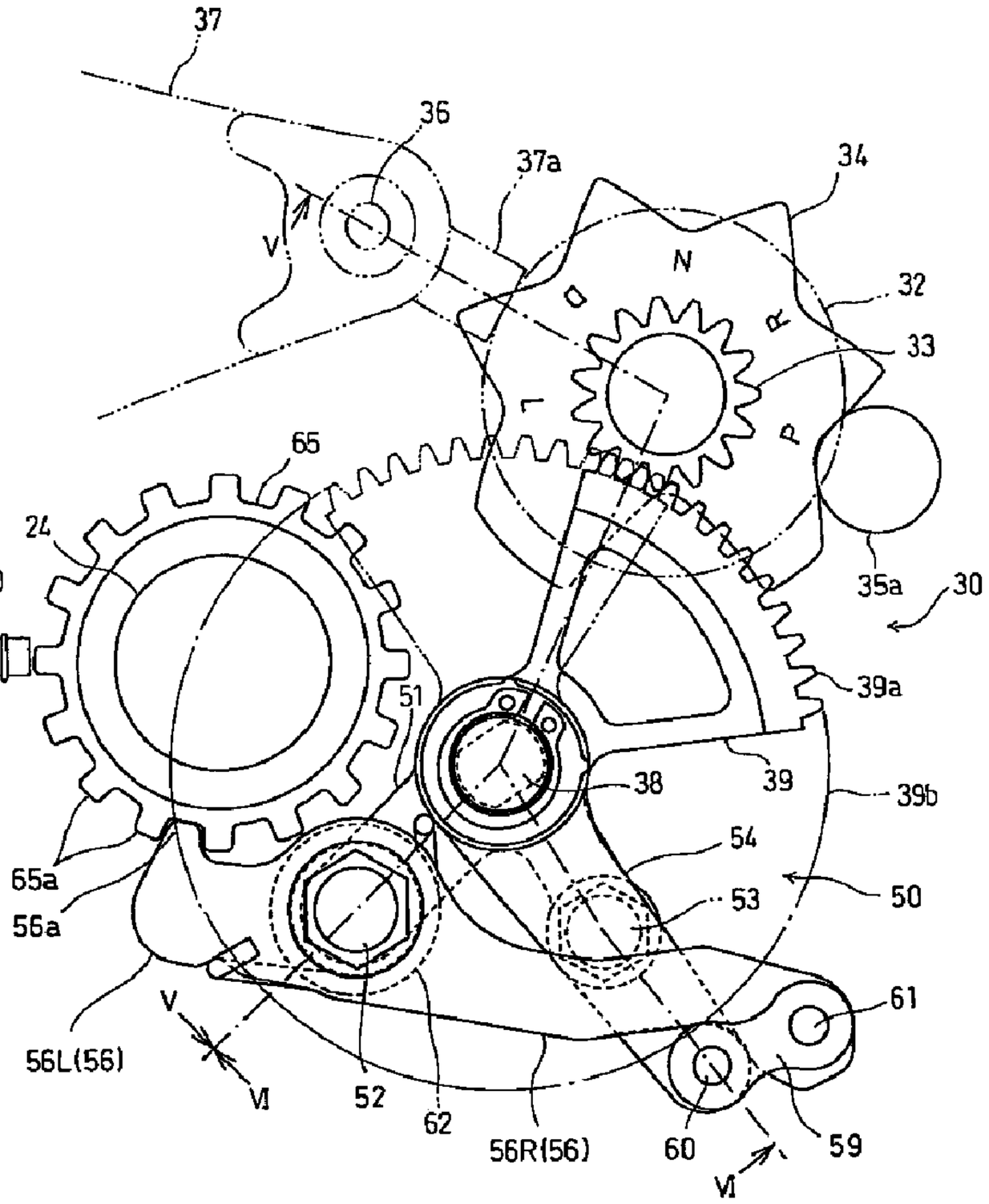

(57) Abrégé/Abstract:
To provide a transmission for an internal combustion apparatus wherein a parking locking mechanism is formed commonly with an upstream side portion of a power transmission system of a shift change mechanism to reduce the number of parts and which can

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(57) Abrégé(suite)/Abstract(continued):
be incorporated compactly in the shift change mechanism to achieve miniaturization of the internal combustion engine. A transmission for an internal combustion engine wherein a shift change mechanism performs a shift change including a parking position in response to an operation of operation means is configured such that it includes a parking locking mechanism which is driven in an interlocking relationship with a working portion of the shift change mechanism, and that, if the shift change mechanism is set to the parking position, then a one-rotation shaft of the transmission is locked against rotation by the parking locking mechanism thereby to restrict rotation of the one-rotation shaft.

ABSTRACT OF THE DISCLOSURE

To provide a transmission for an internal combustion apparatus wherein a parking locking mechanism is formed commonly with an upstream side portion of a power transmission system of a shift change mechanism to reduce the number of parts and which can be incorporated compactly in the shift change mechanism to achieve miniaturization of the internal combustion engine. A transmission for an internal combustion engine wherein a shift change mechanism performs a shift change including a parking position in response to an operation of operation means is configured such that it includes a parking locking mechanism which is driven in an interlocking relationship with a working portion of the shift change mechanism, and that, if the shift change mechanism is set to the parking position, then a one-rotation shaft of the transmission is locked against rotation by the parking locking mechanism thereby to restrict rotation of the one-rotation shaft.

SPEED CHANGE GEAR FOR AN INTERNAL COMBUSTION ENGINE

FIELD OF THE INVENTION

This invention relates to a transmission for an internal combustion engine which includes a parking locking mechanism.

BACKGROUND OF THE INVENTION

Various examples of a transmission for an internal combustion engine wherein a parking position can be selected in response to an operation of a shift select lever for performing a shift change and which includes a parking locking mechanism for restricting rotation of a drive shaft when the vehicle is stopped and the parking position is selected and then the internal combustion engine is stopped have been proposed.

For example, in a parking locking mechanism disclosed in Japanese Patent Laid-Open No. 2004-353739, a parking actuator separate from a gear shift actuator is controlled and driven by control means to activate the parking locking mechanism.

As an embodiment in Japanese Patent Laid-Open No. 2004-353739, a configuration is disclosed wherein, if an electric motor which forms a parking actuator is driven, an engaging member is projected through a pinion-rack mechanism and a coil spring, whereupon a tooth at an end of the engaging

member is engaged with a parking gear fitted on an input power shaft of a speed change gear thereby to compulsorily restrict rotation of the input power shaft.

Since the conventional parking locking mechanism is configured such that a power transmission system is formed as an independent apparatus which is fully separate system from a shift change mechanism and is driven by an actuator for exclusive use, it includes a great number of parts and increases the size of the internal combustion engine.

The present invention has been made in view of such a situation as described above, and it is an object of the present invention to provide a transmission for an internal combustion apparatus wherein a parking locking mechanism is formed commonly with an upstream side portion of a power transmission system of a shift change mechanism to reduce the number of parts and which can be incorporated compactly in the shift change mechanism to achieve miniaturization of the internal combustion engine.

SUMMARY OF THE INVENTION

The present invention provides for a transmission for an internal combustion engine wherein a shift change mechanism performs a shift change including a parking position in response to an operation of operation means, is configured such that the transmission includes a parking locking mechanism which is driven in an interlocking relationship with a working portion of the shift change mechanism, and that, if the shift change mechanism is set to the parking position, then a one-rotation shaft of the transmission is locked against rotation by the parking locking mechanism thereby to restrict rotation of the one-rotation shaft.

According to the present invention, the parking locking apparatus is driven in an interlocking relationship with the working portion of the shift change mechanism. Therefore, the parking locking mechanism is formed commonly with an upstream side portion of a power transmission system of the shift change mechanism, and is driven making use of the operation means of the shift change mechanism, actuator and so forth as well as the working portion. Consequently, the parking locking apparatus can be incorporated compactly in the shift change

mechanism without requiring operation means, an actuator and so forth for exclusive use for parking locking. Consequently, miniaturization of the internal combustion engine can be achieved.

Further, if the shift change mechanism is set to the parking position, then the one-rotation shaft of the transmission is locked by the parking locking mechanism thereby to restrict rotation of the one-rotation shaft. Consequently, the operation is made simple and convenient and the operability is good.

According to an aspect of the invention, the transmission for an internal combustion engine according to the above is configured such that the parking locking apparatus includes a locking member which is driven in an interlocking relationship with the working portion of the shift change mechanism and has a pawl portion which is engaged with a locking portion provided integrally on an output power shaft which is the one-rotation shaft of the transmission thereby to restrict rotation of the output power shaft.

According to this aspect of the invention, the pawl portion of the locking member which is driven in an interlocking relationship with the working portion of the shift change mechanism is engaged with the locking portion provided integrally on the output power shaft of the transmission thereby to restrict rotation of the output power shaft. Consequently, rotation of the output power shaft can be restricted with certainty with a simple configuration.

According to another aspect of the invention, the transmission for an internal combustion engine according to the above is configured such that the shift change mechanism includes a gear shift arm fitted with a shift spindle which is the working portion which is rotated by the operation of the operation means and a shift drum which meshes with and is rotated by the gear shift arm thereby to perform the shift change, and the parking locking mechanism is driven in an interlocking relationship with the rotation of the shift spindle to lock the output power shaft which is the one-rotation shaft, and the gear shift arm forms a sectoral shape having a pivot at the shift spindle while the output power shaft is

disposed outside a range of pivotal motion of the gear shift arm within a maximum diameter of the pivotal motion of the gear shift arm.

According to this aspect of the invention, the output power shaft is disposed at a position which is outside the range of pivotal motion of the sectoral gear shift arm pivoted around the shift spindle and which overlaps with a circle of the maximum diameter of the pivotal motion. Therefore, the shift spindle can be positioned in the proximity of the output power shaft and the parking locking mechanism can be incorporated compactly.

According to a further aspect of the invention, the transmission for an internal combustion engine according to the above is configured such that the locking member of the parking locking mechanism is a lever supported for rocking motion on a fixed support shaft and has a fulcrum and a point of action at the fixed support shaft and the pawl portion, respectively, and the distance of a power point of the lever from the fulcrum is set greater than the distance of the pawl portion which is the point of action from the fulcrum.

According to this aspect of the invention, the distance of the power point of the lever which is a locking member from the fulcrum is set greater than the distance of the pawl portion which is the point of action from the fulcrum. Therefore, by the principle of the lever, even where the parking locking mechanism is small in size, engagement and disengagement of the pawl portion with and from the locking portion of the output power shaft can be performed smoothly with doubled force.

According to another aspect of the invention, the transmission for an internal combustion engine according to the above is configured such that the shift spindle, a drum shaft of the shift drum and the output power shaft are disposed in a mutually neighboring relationship so as to form vertices of a triangle.

According to this aspect of the invention, since the shift spindle, the drum shaft of the shift drum and the output power shaft are disposed in a mutually

neighboring relationship so as to form the vertices of a triangle, the shift change mechanism can be configured compactly.

According to yet another aspect of the invention, the transmission for an internal combustion engine according to the above is configured such that an end portion of the shift spindle is formed from a removable separate member, and the parking locking mechanism is connected to the end portion of the shift spindle so as to be interlocked with the shift spindle.

According to this aspect of the invention, the end portion of the shift spindle is formed from a removable separate member, and the parking locking mechanism is connected to the end portion of the shift spindle so as to be interlocked with the shift spindle. Therefore, by connecting the parking locking mechanism to the end portion so as to form a unit, the assemblage performance can be enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are shown in the drawings, wherein:

FIG. 1 is a side elevational view of an entire four-wheel saddle type vehicle on which an internal combustion engine including a transmission according to an embodiment of the present invention is carried.

FIG. 2 is a perspective view of a shift select apparatus.

FIG. 3 is a schematic rear elevational view of the present internal combustion engine.

FIG. 4 is a rear elevational view showing a shift change mechanism and a parking locking apparatus.

FIG. 5 is a sectional view taken along line V-V of FIG. 4.

FIG. 6 is a sectional view taken along line VI-VI of FIG. 4.

FIG. 7 is a developed view of a shift drum.

FIG. 8 is an explanatory view illustrating shift states of the shift change mechanism and the parking locking apparatus in order.

FIG. 9 is a view illustrating shift states next to those in FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the following, an embodiment according to the present invention is described with reference to FIGS. 1 to 9.

A four-wheel saddle type vehicle 1 for traveling on an irregular ground which incorporates an internal combustion engine including a transmission according to the present embodiment is shown in FIG. 1.

A pair of front wheels 3, 3 are disposed on the opposite sides of a front portion of a vehicle body frame 2 and a pair of rear wheels 4, 4 are disposed on the opposite sides of a rear portion of the vehicle body frame 2 to support a vehicle body. A steering handle bar 5 for steering the front wheels 3, 3 is provided at an upper portion of a front portion of the vehicle body.

A fuel tank 6 is disposed rearwardly of the steering handle bar 5, and a seat 7 is provided rearwardly of the fuel tank 6.

An internal combustion engine 10 is carried at a central portion of the vehicle body by the vehicle body frame 2.

A shift select apparatus 8 is disposed on the left side of the fuel tank 6 above a left side portion of the internal combustion engine 10.

The shift select apparatus 8 is formed such that a shift select lever 9 is tilted forwardly or backwardly to perform a shift changing operation as seen in FIG. 2. A parking operation position P, a reverse operation position R, a neutral

operation position N, a drive operation position D and a low operation position L are indicated in order along the tilting motion of the shift select lever 9.

The shift select lever 9 is tilted only in the forward and backward direction and is operated forwardly or backwardly by a driver so as to be selectively positioned to a required operation position to perform a shift change.

The parking operation position P is positioned most forwardly.

The tilting motion of the shift select lever 9 is transmitted to the transmission through a cable not shown.

The internal combustion engine 10 carried at a central portion of the vehicle body is a water-cooled single-cylinder four-stroke cycle internal combustion engine and is carried vertically with a crankshaft 11 thereof directed forwardly and backwardly such that power thereof is transmitted to the four wheels.

FIG. 3 is a schematic rear elevational view of the internal combustion engine 10.

The internal combustion engine 10 includes an engine body which is formed from a cylinder 13 in which a piston is fitted for back and forth movement, a cylinder head 14 and a head cover 15 placed in order on the cylinder 13 and coupled to each other, and a crankcase 12 coupled to a rear end portion of the cylinder 13.

The crankcase 12 is a case divided into front and rear members, and the crankshaft 11 is supported for rotation on the front and rear crankcase 12 members and connected to the piston through a connecting rod 16 such that back and forth movement of the piston is converted into and transmitted as rotation of the crankshaft 11.

A transmission 20 is disposed on the left side of the crankcase 12.

A main shaft 21 is disposed at a substantially equal height leftwardly of the crankshaft 11. A counter shaft 22 is disposed obliquely downwardly on the left side of the main shaft 21 while a reverse shaft 23 is disposed above the counter shaft 22. An output power shaft 24 is disposed obliquely downwardly of the counter shaft 22 and substantially just below the main shaft 21.

A driving gear wheel 11a connected to the crankshaft 11 through a start clutch is held in meshing engagement with a driven gear wheel 21a of the main shaft 21, and a speed change gear train group 25 is formed between the main shaft 21 and the counter shaft 22. Upon reversal, reverse gears 26 of the reverse shaft 23 are interposed between the main shaft 21 and the counter shaft 22.

A shift drum shaft 31 is disposed rightwardly of the counter shaft 22 and rightwardly upwards of the output power shaft 24 and integrally supports a shift drum 32 thereon. Two shift forks 37a and 37b are supported for pivotal motion on a guide shaft 36 disposed between the shift drum shaft 31 and the counter shaft 22.

The shift forks 37a and 37b engage at ends thereof with a sliding member fitted on the counter shaft 22, and shift pins 37ap and 37bp projecting from base end portions of the shift forks 37a and 37b are fitted in shift grooves 37a and 37b formed on an outer circumferential face of the shift drum 32 (refer to FIGS. 5 and 7).

As seen in FIG. 7 which is a developed view of the shift drum 37, the two shift grooves 37a and 37b are formed on the outer circumferential face of the shift drum, and a parking position P, a reverse position R, a neutral position N, a drive position D and a low position L are provided in the order of the angle of rotation of the shift drum 37.

Although the parking position P and the neutral position N are same in the axial direction of the shift forks 37a and 37b, since the reverse position R at which the shift groove 37a is curved is disposed between the parking position P and the neutral position N, such a situation that the shift forks 37a and 37b enter the

parking position P from the neutral position N although the shift select lever 9 is not operated is prevented without increasing the size of the shift drum 37.

Referring to FIG. 3, an oil strainer 17 is provided along the bottom face of the rear crankcase 12 member and is formed on the inner side (front side) with respect to a mating face 12a of the rear crankcase 12 member with a rear crankcase cover (not shown).

It is to be noted that a drum driven gear wheel 33 and a shift cam 34 are fitted integrally on the shift drum shaft 31 as seen in FIGS. 4 and 5.

The shift cam 34 is in the form of a star-shaped plate and has trough portions of a predetermined shape formed on an outer periphery thereof in order in the counterclockwise direction for the parking position P, reverse position R, neutral position N, drive position D and low position L. When a stopper roller 35a supported for rotation at an end of a stopper arm 35 biased in one pivotal direction is pressed against the outer periphery of the shift cam 34, the stopper roller 35a can be received stably by any of the troughs at the positions thereby to set the shift drum 32 to a predetermined angular position.

A shift spindle 38 is disposed at a position below the shift drum shaft 31 and rightwardly of the output power shaft 24, and a gear shift arm 39 is provided and fitted at a base end portion thereof with the shift spindle 38.

The gear shift arm 39 has a sectoral shape having a pivot at the shift spindle 38, and a shift driving gear 39a is formed along an end edge of the developed sectoral shape of the gear shift arm 39. The shift driving gear 39a is held in meshing engagement with the drum driven gear wheel 33 fitted on the shift drum shaft 31.

Since the output power shaft 24 is positioned on the left side position of the sectoral gear shift arm 39 outside the range of pivotal motion of the gear shift arm 39, the output power shaft 24 and the shift spindle 38 are positioned near to each other.

In particular, referring to FIG. 4, the output power shaft 24 is disposed at a position overlapping with a circle 39b of a maximum diameter of pivotal motion of the sectoral gear shift arm 39 which is pivoted around the shift spindle 38 (distance from the shift spindle 38 to a pivotal end edge of the gear shift arm 39).

The shift spindle 38 extends at a front end thereof through the crankcase 12 and a front cover (not shown) of the internal combustion engine 10 and projects forwardly, and motion instruction transmission means such as a cable extending from the shift select lever 9 is coupled to a front end portion of the shift spindle 38 so that the shift spindle 38 is rotated by a tilting movement of the shift select lever 9.

Where a shift change mechanism 30 is formed in such a manner as described above and the shift spindle 38 is rotated by an operation of the shift select lever 9, the sectoral gear shift arm 39 is pivoted, whereupon the shift drum shaft 31 is rotated together with the shift drum 32 through the meshing engagement between the shift driving gear 39a and the drum driven gear wheel 33. Then, the shift forks 37a and 37b are moved in an axial direction under the guidance of the shift grooves 37a and 37b of the rotated shift drum 32 to slidably move the sliding member of the counter shaft 22 thereby to change meshing gear wheels of the speed change gear train group 25 to perform a shift change.

When the shift select lever 9 is tilted most forwardly, it assumes the parking operation position P, and as the shift select lever 9 is pivoted rearwardly from the parking operation position P, it successively assumes the reverse operation position R, neutral operation position N, drive operation position D and low operation position L.

By such rearward tilting movement of the shift select lever 9, the shift spindle 38 is rotated in the counterclockwise direction in FIG. 3 through the cable and so forth, and the shift drum shaft 31 is rotated in the clockwise direction through the meshing engagement between the shift driving gear 39a and the drum driven gear wheel 33. Thereupon, the stopper roller 35a is successively fitted into the

troughs formed on the outer periphery of the shift cam 34 to successively set the shift drum 32 to a predetermined angular position. Consequently, the meshing engagement of the speed change gear train group 25 can be successively shifted and changed to the parking position P, reverse position R, neutral position N, drive position D and low position L.

According to the present transmission 20, a parking locking apparatus 50 is incorporated in the shift change mechanism 30 described above.

The shift spindle 38 is formed at a rear end portion thereof from a rear end spindle 38b of a separate member, and serrations formed on an inner circumferential face of a connecting cylindrical portion 38bb of the rear end spindle 38b mesh with serrations formed on an outer circumferential face of a rear portion of a body spindle 38a so that the body spindle 38a and the rear end spindle 38b can rotate coaxially and integrally with each other.

The body spindle 38a extends through and projects rearwardly from the rear side crankcase 12 member, and the gear shift arm 39 is serration fitted at a rear end portion thereof with the serrations of the projecting portion of the body spindle 38a and is prevented from being pulled off by a stop ring 40. The rear end spindle 38b is serration fitted removably with a further tip end portion of the body spindle 38a.

The rear end spindle 38b is supported for rotation on a parking lock holder 51.

The parking lock holder 51 is securely mounted on the crankcase 12 by means of to bolts of a first bolt 52 and a second bolt 53 (refer to FIG. 6).

The parking lock holder 51 is assembled to the inner side (front side) with respect to the mating face 12a of the crankcase 12 with the rear crankcase cover (not shown).

The rear end spindle 38b extends at an end thereof through and projects rearwardly from the parking lock holder 51, and a driving arm 54 is fitted at a

base end portion thereof with the end of the rear end spindle 38b and is prevented from being pulled off by a stop ring 55.

The driving arm 54 is positioned at a position in an axial direction along the mating face 12a of the crankcase 12.

The first bolt 52 for securely mounting the parking lock holder 51 on the rear side crankcase 12 member is disposed at a position considerably near to and rightwardly obliquely downwardly of the output power shaft 24.

The first bolt 52 secures the parking lock holder 51 while it supports a parking locking lever 56 for rocking motion.

In particular, as seen in FIG. 6, a washer 57 and a sleeve 58, on which the parking locking lever 56 is fitted for rocking motion, are provided at an open end of a through-hole of the parking lock holder 51 for the first bolt 52, and the first bolt 52 extends through the washer 57 and the sleeve 58 and further through the through-hole of the parking lock holder 51. Further, the parking lock holder 51 is screwed in and fastened to the crankcase 12, and the parking locking lever 56 is supported for rocking motion on the first bolt 52 through the sleeve 58.

The parking locking lever 56 extends leftwardly and rightwardly from the first bolt 52, and the right side extension 56R is elongated and is connected at the right end thereof to the driving arm 54 through a link member 59.

The parking locking lever 56 is positioned rearwardly of the driving arm 54 and crosses the driving arm 54 such that it overlaps in an axial direction on the driving arm 54. The driving arm 54 has a boss portion 54a projecting rearwardly from an end thereof such that a rear end of the boss portion 54a is positioned in flush with a rear face of the parking locking lever 56.

The link member 59 is supported at an end thereof for pivotal motion on the boss portion 54a of the driving arm 54 by a pin 60 and supported at the other end thereof for pivotal motion at an end of the parking locking lever 56 by a pin 61

thereby to connect the end of the driving arm 54 and the end of the parking locking lever 56 to each other.

Meanwhile, the left side extension 56L of the parking locking lever 56 which extends leftwardly from the first bolt 52 is shorter, and a pawl 56a projects from an end portion of the left side extension 56L toward the output power shaft 24.

A parking gear wheel 65 is fitted integrally on the output power shaft 24 such that, if the pawl 56a of the parking locking lever 56 is meshed with teeth 65a of the parking gear wheel 65, then rotation of the output power shaft 24 is inhibited.

The parking locking lever 56 is biased by a torsion spring 62 in a direction in which the pawl 56a of the left side extension 56L thereof meshes with the teeth 65a of the parking gear wheel 65.

It is to be noted that the teeth 65a of the parking gear wheel 65 have a rectangular cross section, and also a groove between one and another one of the teeth 65a has a channel shape. Meanwhile, an end of the pawl 56a of the parking locking lever 56 projects with a curved face shaped such that it is fitted in a channel-shaped groove of the parking gear wheel 65 to restrict rotation of the output power shaft 24 with certainty whereas it can be removed readily from the groove.

A velocity sensor 70 in the form of a magnetic detector is disposed in the proximity of the teeth 65a of the parking gear wheel 65 such that it can detect the teeth 65a revolved in the proximity of a detection portion of the velocity sensor 70 to detect the velocity of the vehicle based on rotation of the output power shaft 24.

While the output power shaft 24 is positioned in an overlapping relationship with the circle 39b of the maximum diameter of pivotal motion of the sectoral gear shift arm 39 which pivots around the shift spindle 38, the output power shaft 24 is disposed at a position in the proximity of the shift spindle 38 at which the teeth 65a of the parking gear wheel 65 approaches the shift spindle 38 as seen in FIG. 4.

Accordingly, the parking locking apparatus 50 can be incorporated compactly in the shift change mechanism 30, and this can contribute to miniaturization of the internal combustion engine 10.

The parking locking apparatus 50 is configured in such a manner as described above and is formed as a unit in such a manner that it is held by the parking lock holder 51.

In particular, the driving arm 54 and the parking locking lever 56 extend through and are held by the parking lock holder 51 so as to form a unit in a state wherein the driving arm 54 fitted on the rear end spindle 38b of the shift spindle 38 and the parking locking lever 56 supported for rotation on the first bolt 52 are connected to each other by the link member 59.

The parking locking apparatus 50 retained by and forming a unit together with the parking lock holder 51 in this manner is fitted at the rear end spindle 38b thereof with the body spindle 38a fitted in advance with the gear shift arm 39 at a predetermined position of the crankcase 12 and is fastened by the first bolt 52 and the second bolt 53 attached already.

Accordingly, the parking locking apparatus 50 is superior in assemblage performance.

The parking locking apparatus 50 is assembled in such a manner that it is incorporated in the shift change mechanism 30 as described above. In the parking locking apparatus 50, upon rotation of the shift spindle 38 which is the upstream side of the power transmission system of the shift change mechanism 30, the driving arm 54 is pivoted, whereupon the parking locking lever 56 is rocked through the link member 59. Consequently, the pawl 56a of the left side extension 56L of the parking locking lever 56 is brought into or out of meshing engagement with the teeth 65a of the parking gear wheel 65 of the output power shaft 24.

FIGS. 8 and 9 illustrate shift states of the transmission 20 in order from the parking position.

FIG. 8(1) illustrates a state wherein the shift select lever 9 is operated to tilt to the parking operation position P to set the shift state to the parking position P (same as FIG. 4).

The shift spindle 38 is positioned at an angular position rotated most in the clockwise direction as viewed in rear elevation, and the shift change mechanism 30 is set to the parking position P. Further, the parking locking lever 56 of the parking locking mechanism 50 is positioned at an angular position rocked most in the clockwise direction, in which the pawl 56a of the left side extension 56L meshes with the teeth 65a of the parking gear wheel 65 of the output power shaft 24 to inhibit rotation of the output power shaft 24.

Then, if the shift select lever 9 is operated to tilt rearwardly to the reverse operation position R, then the shift spindle 38 is rotated in the counterclockwise direction as seen in FIG. 8(2) and the shift change mechanism 30 sets its shift state to the reverse position R. Consequently, by the driving arm 54 which is pivoted in the counterclockwise direction together with the shift spindle 38, also the parking locking lever 56 is rocked in the counterclockwise direction through the link member 59 until the pawl 56a of the left side extension 56L is removed from a groove between a tooth 65a and an adjacent tooth 65a of the parking gear wheel 65 thereby to permit free rotation of the output power shaft 24.

At the parking position P, depending upon the angular position of the output power shaft 24, the pawl 56a of the left side extension 56L of the parking locking lever 56 may be meshed firmly with the teeth 65a of the parking gear wheel 65 of the output power shaft 24 such that, when a shift change to the reverse position R is performed, the pawl 56a may not be removed readily from the groove between a tooth 65a and an adjacent tooth 65a of the parking gear wheel 65. However, since the parking locking lever 56 is configured such that the pin 61 which serves as a power point is positioned at an end portion of the elongated right side extension 56R with respect to the first bolt 52 serving as a fulcrum and

the pawl 56a which serves as a point of action is positioned at an end portion of the shorter left side extension 56L and hence the distance from the fulcrum to the point of action is much shorter than the distance from the fulcrum to the power point, doubled acting force acts upon the pawl 56a in accordance with the principle of the lever. Consequently, the pawl 56a can be removed readily from the groove between a tooth 65a and an adjacent tooth 65a of the parking gear wheel 65.

Since the parking locking apparatus 50 has a link structure which makes use of the principle of the lever, it is reduced in size and can be incorporated in the shift change mechanism 30 without occupying a great space.

Then, if the shift select lever 9 is further operated to tilt rearwardly to the neutral operation position N, then the shift spindle 38 is further rotated in the counterclockwise direction as seen in FIG. 8(3). Consequently, the shift change mechanism 30 sets its shift state to the neutral operation position N, and also the parking locking lever 56 is further rocked in the counterclockwise direction, whereupon the pawl 56a of the left side extension 56L is removed from the teeth 65a of the parking gear wheel 65 thereby to permit free rotation of the output power shaft 24.

A state wherein the shift select lever 9 is further tilted to the drive operation position D is illustrated in FIG. 9(4), and a state wherein the shift select lever 9 is further tilted to the low operation position L is illustrated in FIG. 9(5).

Since the parking locking lever 56 is further rocked in the counterclockwise direction, the pawl 56a of the left side extension 56L is further spaced away from the teeth 65a of the parking gear wheel 65 and the output power shaft 24 can rotate freely.

It is to be noted that, in a state wherein the parking locking lever 56 is rocked to the utmost in the counterclockwise direction as seen in FIG. 9(5) at the low operation position L, the parking locking lever 56 is positioned closely to but does not interfere with the mating face 12a of the crankcase 12.

In this manner, when the shift change mechanism 30 is shifted and set to the parking position P, the pawl 56a of the left side extension 56L of the parking locking lever 56 meshes with the teeth 65a of the parking gear wheel 65 to inhibit rotation of the output power shaft 24. However, when the shift change mechanism 30 is set to any position other than the parking operation position P, the pawl 56a of the left side extension 56L of the parking locking lever 56 is spaced away from the teeth 65a of the parking gear wheel 65 and the output power shaft 24 can rotate freely.

As described above, since the present parking locking apparatus 50 is configured such that it is driven by rotation of the shift spindle 38 which is on the upstream side of the power transmission system of the shift change mechanism 30, the parking locking apparatus 50 can be incorporated compactly in the shift change mechanism 30 without requiring operation means, an actuator and so forth for exclusive use for parking locking. Consequently, miniaturization of the internal combustion engine can be achieved.

Further, since the parking locking apparatus 50 has a link structure which makes use of the principle of the lever, it is reduced in size, and further miniaturization of the internal combustion engine can be anticipated.

Further, engagement and disengagement (removal) of the pawl 56a of the parking locking lever 56 of the parking locking apparatus 50 with and from the teeth 65a of the parking gear wheel 65 of the output power shaft 24 can be performed smoothly.

The oil strainer 17 provided at an inlet port for absorbing oil accumulated on the bottom of the crankcase 12 is disposed below the parking locking apparatus 50 as shown in FIG. 3. However, the oil strainer 17 is formed on the inner side with respect to the mating face 12a of the rear crankcase 12 member with the rear crankcase cover (not shown) as described hereinabove, and the oil strainer 17 does not interfere with the driving arm 54 or the parking locking lever 56 which are positioned on the outer side (rear side) with respect to the mating face 12a as seen in FIG. 5.

Only if the shift select lever 9 is operated to tilt to the parking operation position P, the parking locking mechanism operates to inhibit rotation of the output power shaft 24 of the transmission 20 thereby to set parking locking. Consequently, the operation is made simple and convenient and the operability is good.

The gear shift arm 39 fitted on the shift spindle 38 of the shift change mechanism 30 has a sectoral shape, and the output power shaft 24 is disposed outside the range of pivotal motion of the gear shift arm 39 and the shift spindle 38 and the output power shaft 24 are disposed near to each other. Consequently, the parking locking apparatus 50 can be incorporated compactly.

Further, since the shift spindle 38, the drum shaft 31 of the shift drum 32 and the output power shaft 24 are disposed in the proximity of each other at the vertices of a triangle, the shift change mechanism 30 can be formed compactly.

As described hereinabove, the rear end spindle 38b of the shift spindle 38 is formed as a removable separate member to form the parking locking apparatus 50 into a unit. Therefore, the assemblage performance of the parking locking apparatus 50 is enhanced.

Although various preferred embodiments of the present invention have been described herein in detail, it will be appreciated by those skilled in the art, that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A transmission for use in conjunction with an internal combustion engine, the transmission comprising a rotary shaft, a gear selection device, a shift change mechanism operably connected to the gear selection device to perform a shaft change, including movement to a parking position, a parking lock mechanism configured to lock the rotary shaft when the gear selection device is set to the parking position, and a pivotally supported working portion interconnecting the shift change mechanism and the parking lock mechanism such that the rotary shaft is disposed outside a range of pivotal motion of the working portion, and within a maximum diameter of the pivotal motion of the working portion.

2. The transmission for the internal combustion engine according to claim 1, wherein the working portion includes an elongated spindle, a sectoral gear attached to a first end of the spindle, and a power arm attached to a second end of the spindle, wherein the sectoral gear is meshed with the shift change mechanism and the power arm is operably connected to a lever arm of the locking mechanism.

3. The transmission for the internal combustion engine according to claim 1, wherein said rotary shaft comprises an output power shaft, said working portion of said shift change mechanism comprises a gear shift arm fitted on a shift spindle which is rotated by the operation of said gear selection device, and the shift change mechanism further comprises a shift drum which meshes with and is rotated by said gear shift arm thereby to perform the shift change, and wherein said parking lock mechanism is driven in an interlocking relationship with the rotation of said shift spindle to lock said output power shaft, said gear shift arm forms a sectoral shape and pivots at said shift spindle, and said output power shaft is disposed outside a range of pivotal motion of said gear shift arm, and within a maximum diameter of the pivotal motion of said gear shift arm.

4. The transmission for the internal combustion engine according to claim 3, wherein said shift spindle, a drum shaft of said shift drum and said output power shaft are disposed in a mutually neighboring relationship so as to form vertices of a triangle.

5. The transmission for the internal combustion engine according to claim 3, wherein an end portion of said shift spindle is formed as a separate removable member, and said parking lock mechanism is connected to the end portion of said shift spindle so as to be interlocked with said shift spindle.

6. The transmission for the internal combustion engine according to claim 3, wherein the shift spindle comprises a body spindle portion and a rear end spindle portion which is a separate member from the body spindle portion, and wherein the body spindle portion and rear end spindle portion are connected so as to rotate coaxially and integrally with each other.

7. The transmission for the internal combustion engine according to claim 1, wherein said rotary shaft comprises an output power shaft, said working portion of said shift change mechanism comprises a gear shift arm fitted on a shift spindle which is rotated by the operation of said gear selection device, and the shift change mechanism further comprises a shift drum which meshes with and is rotated by said gear shift arm thereby to perform the shift change, and wherein said parking lock mechanism comprises: a parking lock holder secured to an engine housing via a bolt and configured to receive the shift spindle therethrough; a locking lever extending transversely to an axis of the shift spindle, the locking lever comprising a first end formed into a pawl, and a second end opposed to the first end, the locking lever pivotable about said bolt at a fulcrum location between said first and second ends thereof; a driving arm connected at a first end to the shift spindle; and a link member connecting a second end of the driving arm to the second end of the locking lever, such that when the shift spindle is rotated in a first direction to a maximum extent of the gear shift arm, the locking lever is rotated such that the pawl engages with the output power shaft so as to prevent rotation of the output power shaft, and when the shift spindle is rotated in a second direction, the pawl disengages from the output power shaft so as to permit free rotation of the output power shaft.

8. A transmission for an internal combustion engine, the transmission comprising an output power shaft, a gear selection device, a shift change mechanism operably connected to the gear selection device to perform a shift change, including movement to a parking position, a parking lock mechanism configured to lock the rotary shaft when the gear selection device is set to the

parking position, and a working portion axially interconnecting the shift change mechanism and the parking lock mechanism, wherein the working portion axially spaces the parking lock mechanism apart from the shift change mechanism; said working portion including a rotatable spindle, a shift gear attached to said spindle, and a power arm attached to said spindle and operably connected to a lever arm of the locking mechanism; and wherein said shift gear is meshed with said shift change mechanism.

9. The transmission for the internal combustion engine according to claim 8, wherein said spindle is elongate and said shift gear is a sectoral gear attached to a first end of the spindle, and said power arm is attached to a second end of the spindle.

10. A transmission for use in conjunction with an internal combustion engine, the transmission comprising a rotary shaft, a gear selection device, a shift change mechanism operably connected to the gear selection device to perform a shaft change, including movement to a parking position, a parking lock mechanism configured to lock the rotary shaft when the gear selection device is set to the parking position, and a pivotally supported working portion interconnecting the shift change mechanism and the parking lock mechanism such that the rotary shaft is disposed outside a range of pivotal motion of the working portion, and within a maximum diameter of the pivotal motion of the working portion; and wherein the working portion comprises a shift spindle and a gear shift arm fitted thereto, and wherein the shift change mechanism further comprises a shift drum which meshes with and is rotated by said gear shift arm thereby to perform the shift change, and wherein said gear shift arm forms a sectoral shape and pivots at said shift spindle, and said output power shaft is disposed outside a range of pivotal motion of said gear shift arm, and within a maximum diameter of the pivotal motion of said gear shift arm.

11. The transmission for the internal combustion engine according to claim 10, wherein said shift spindle, a drum shaft of said shift drum and said output power shaft are disposed in a mutually neighboring relationship so as to form vertices of a triangle.

12. The transmission for the internal combustion engine according to claim 10, wherein an end portion of said shift spindle is formed as a separate

removable member, and said parking lock mechanism is connected to the end portion of said shift spindle so as to be interlocked with said shift spindle.

13. A vehicle having the transmission of claim 1 installed therein.

14. The vehicle of claim 13, wherein the vehicle is an all-terrain vehicle.

15. A vehicle having the transmission of claim 8 installed therein.

16. The vehicle of claim 15, wherein the vehicle is an all-terrain vehicle.

17. A transmission for use in conjunction with an internal combustion engine, the transmission comprising a rotary shaft, a gear selection device, a shift change mechanism operably connected to the gear selection device to perform a shift change, including movement to a parking position, a pivotally supported parking lock lever having a lever arm on a first end and a locking element disposed on a second end with a pivot point disposed between the first and second end, and a working portion including a sectoral gear in mesh with the shift change mechanism and connecting said shift change mechanism to the lever arm of the parking lock lever, wherein the locking element of the parking lock lever is configured to lock the rotary shaft when the gear selection device is set to the parking position; wherein the working portion includes a shift spindle with a shift arm pivotally fitted thereto and meshed with the shift change mechanism

18. The transmission for the internal combustion engine according to claim 17, wherein the distance between the lever arm and the pivot point is greater than the distance between the pivot point and the locking element.

19. The transmission for the internal combustion engine according to claim 17, wherein the working portion includes a shift spindle with a shift arm pivotally fitted thereto and meshed with the shift change mechanism, wherein the rotary shaft is disposed outside a range of pivotal motion of the shift arm, and within a maximum diameter of the pivotal motion of the shift arm.

20. A vehicle having the transmission of claim 17 installed therein.

NAME OF DOCUMENT DRAWINGS

FIG. 1

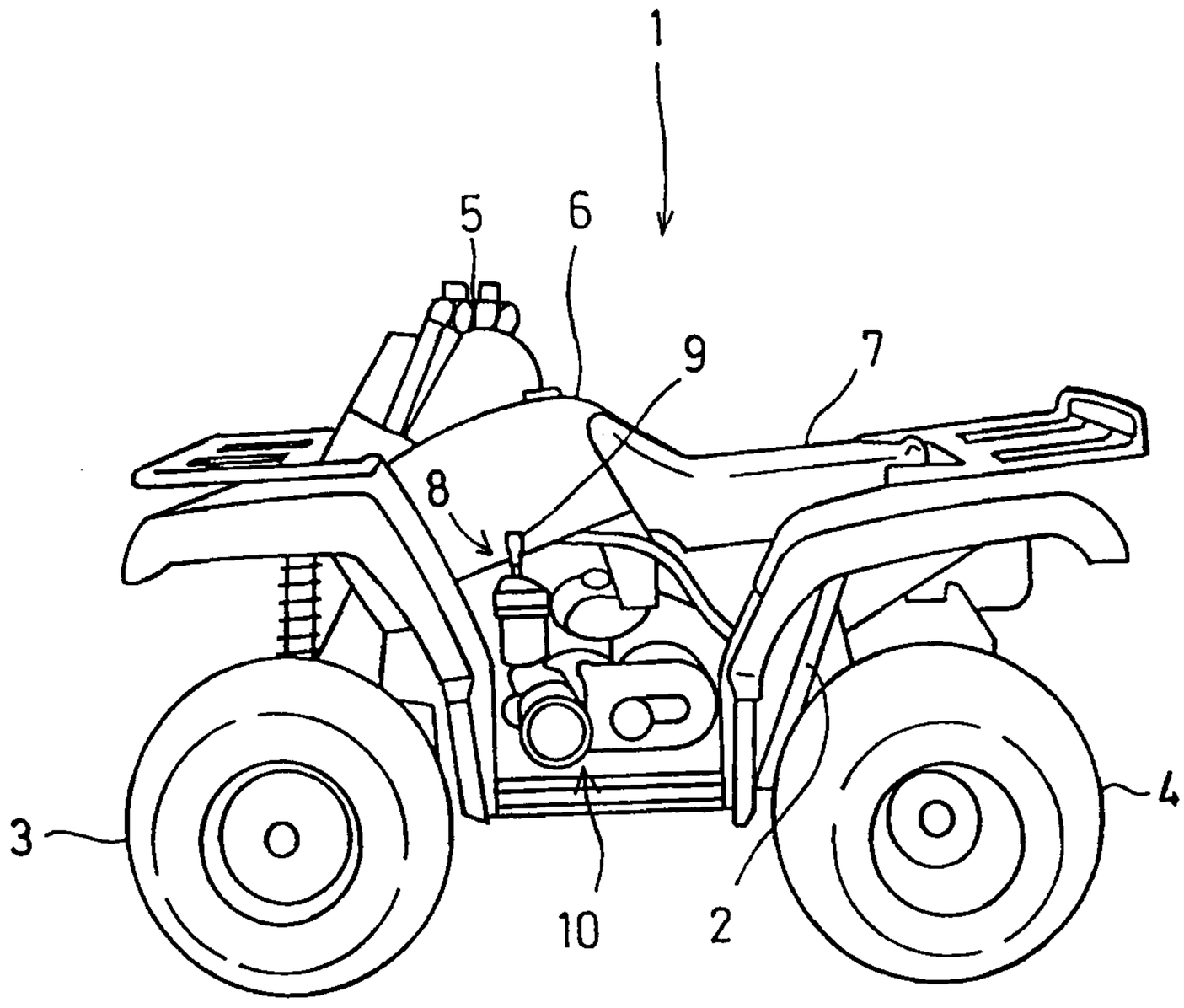

FIG. 2

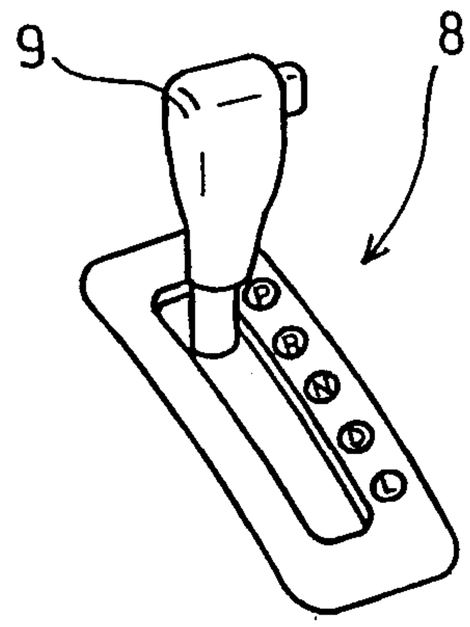

FIG. 3

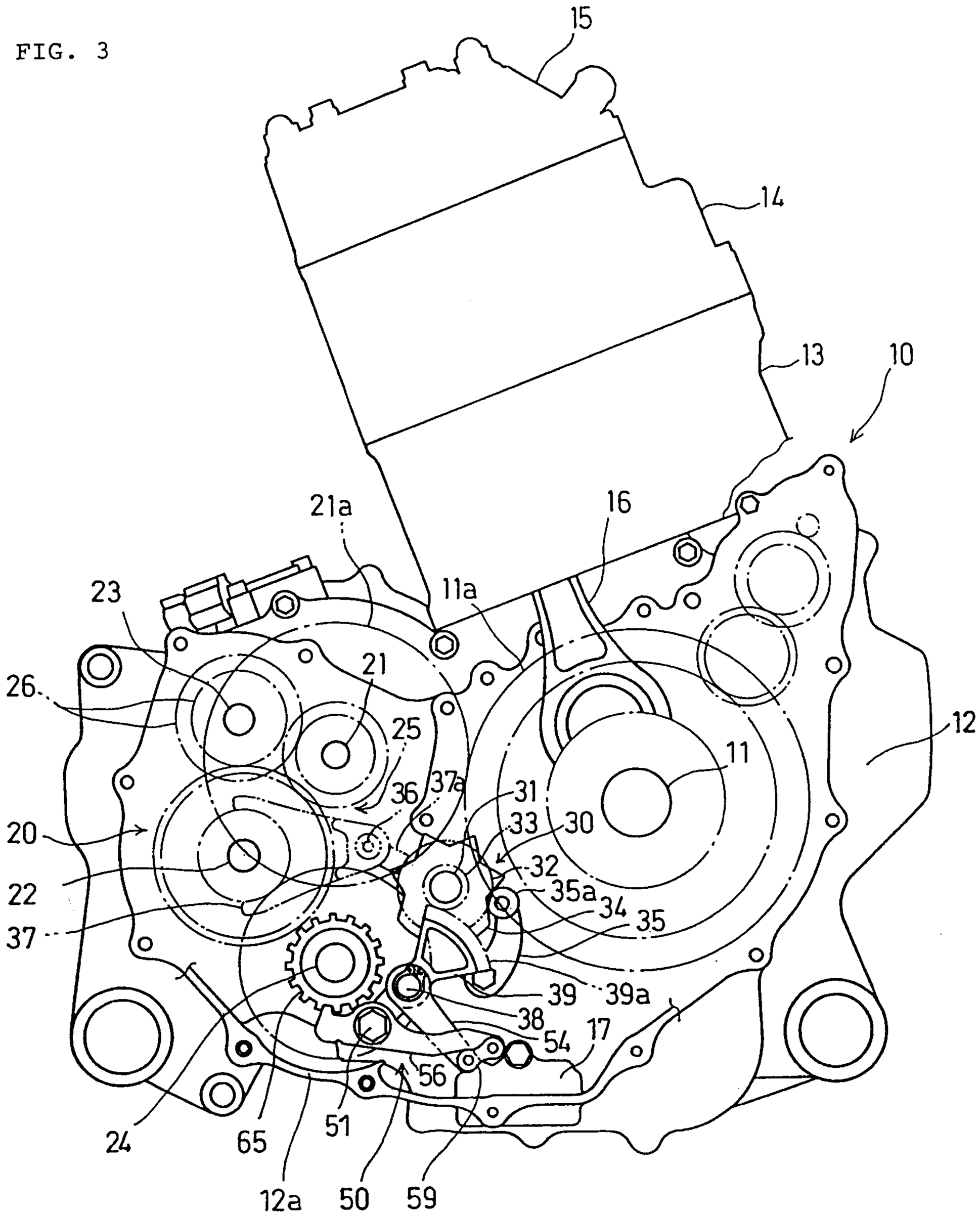
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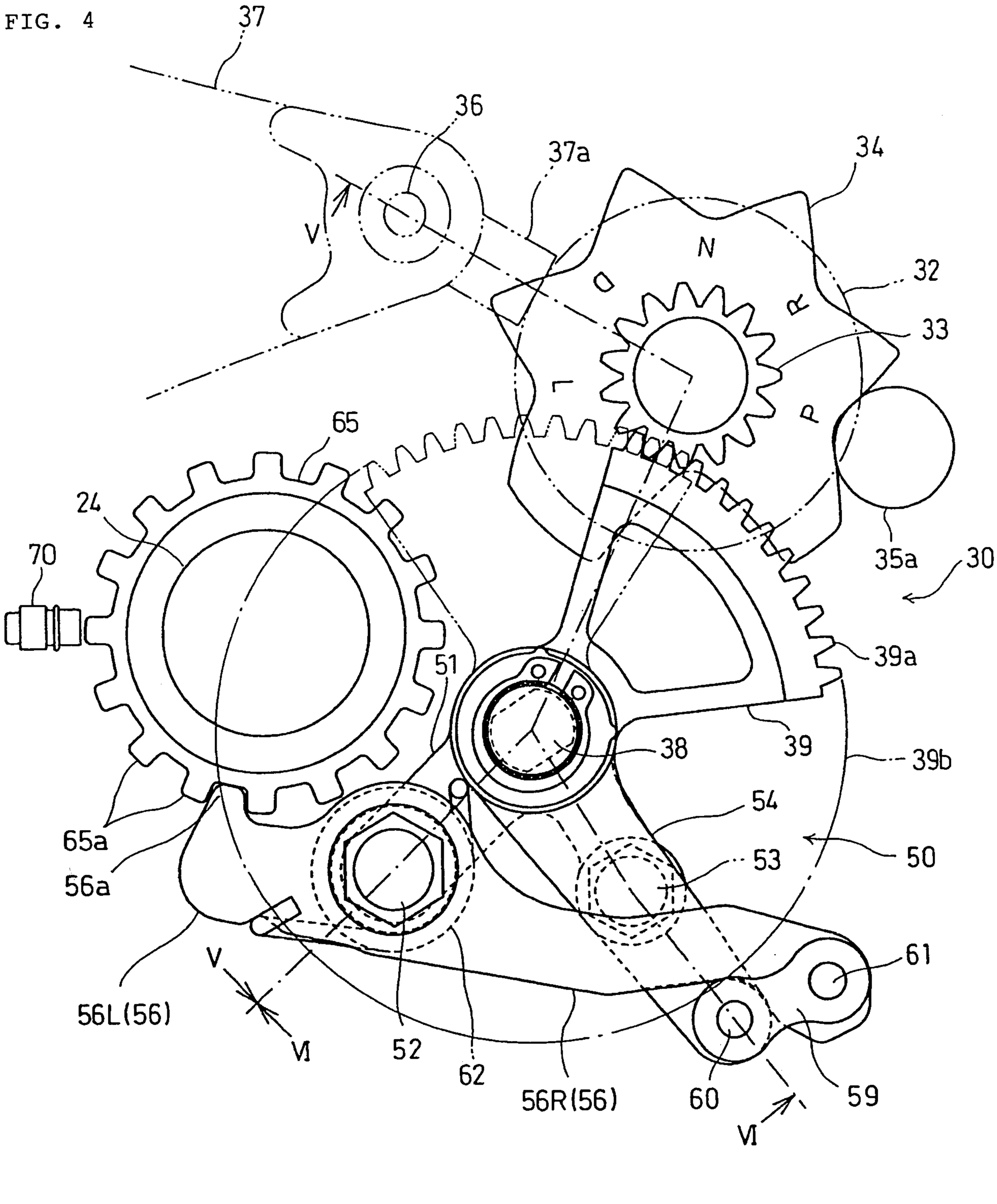
FIG. 4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VI

FIG. 5

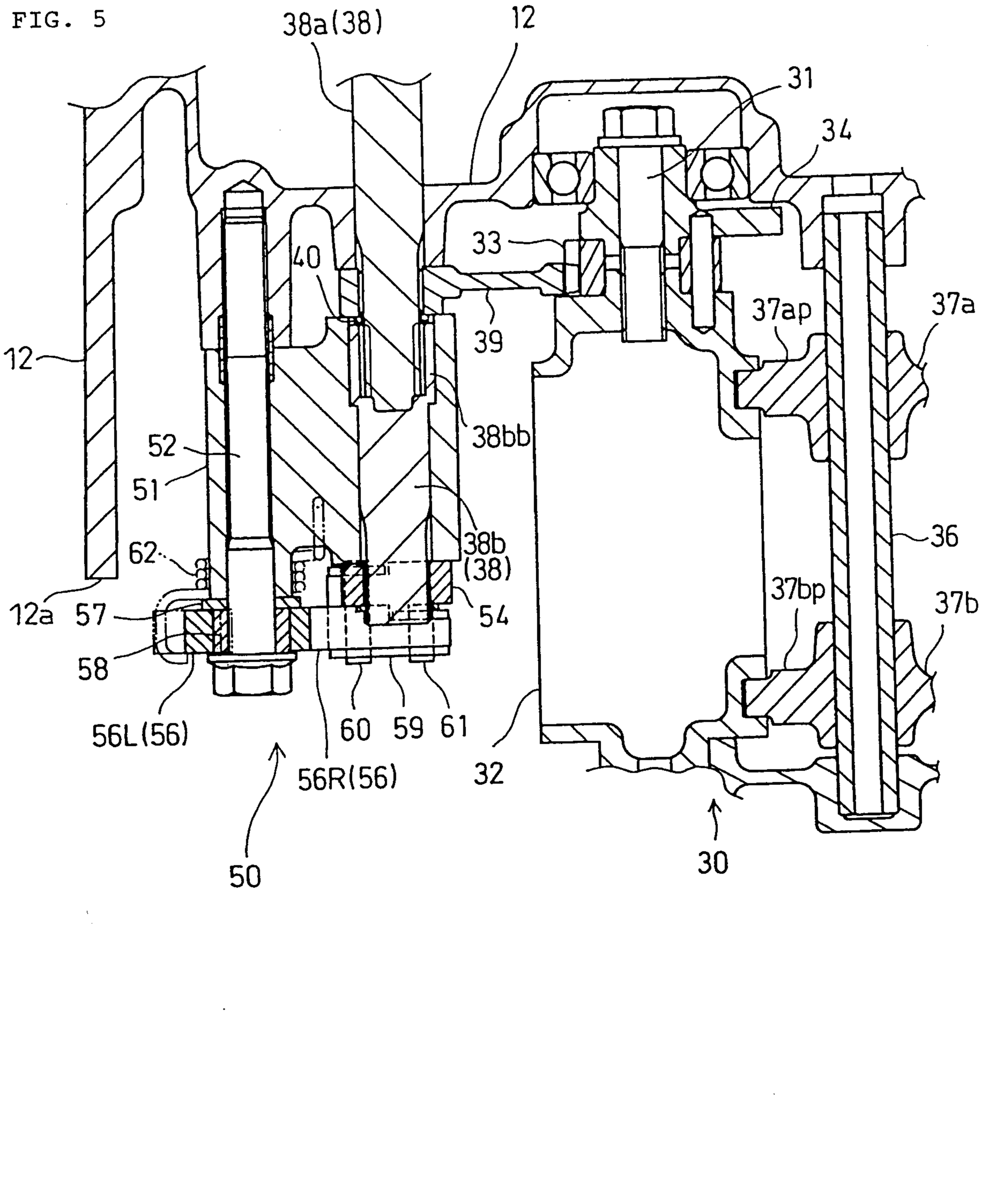
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FIG. 6

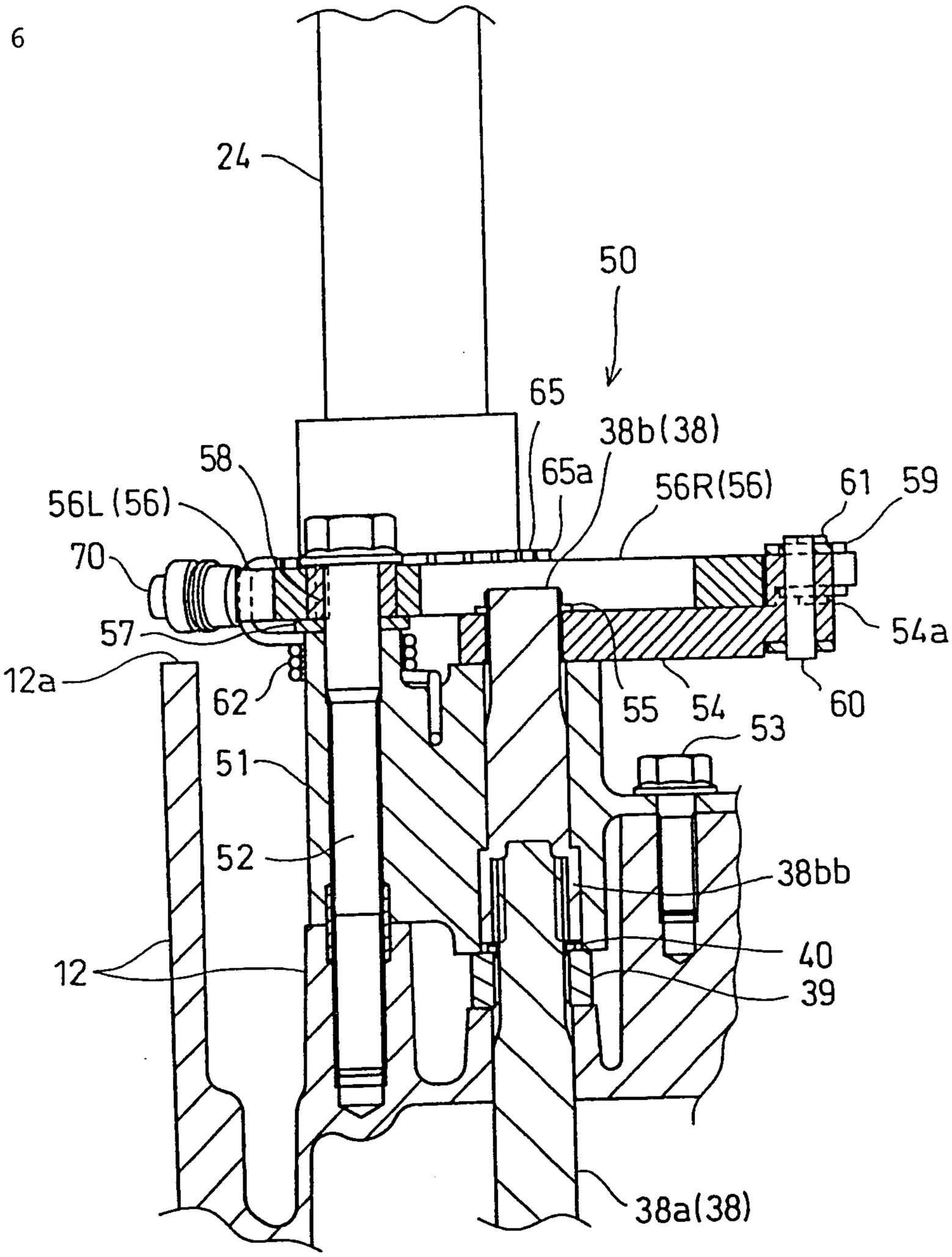
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FIG. 7

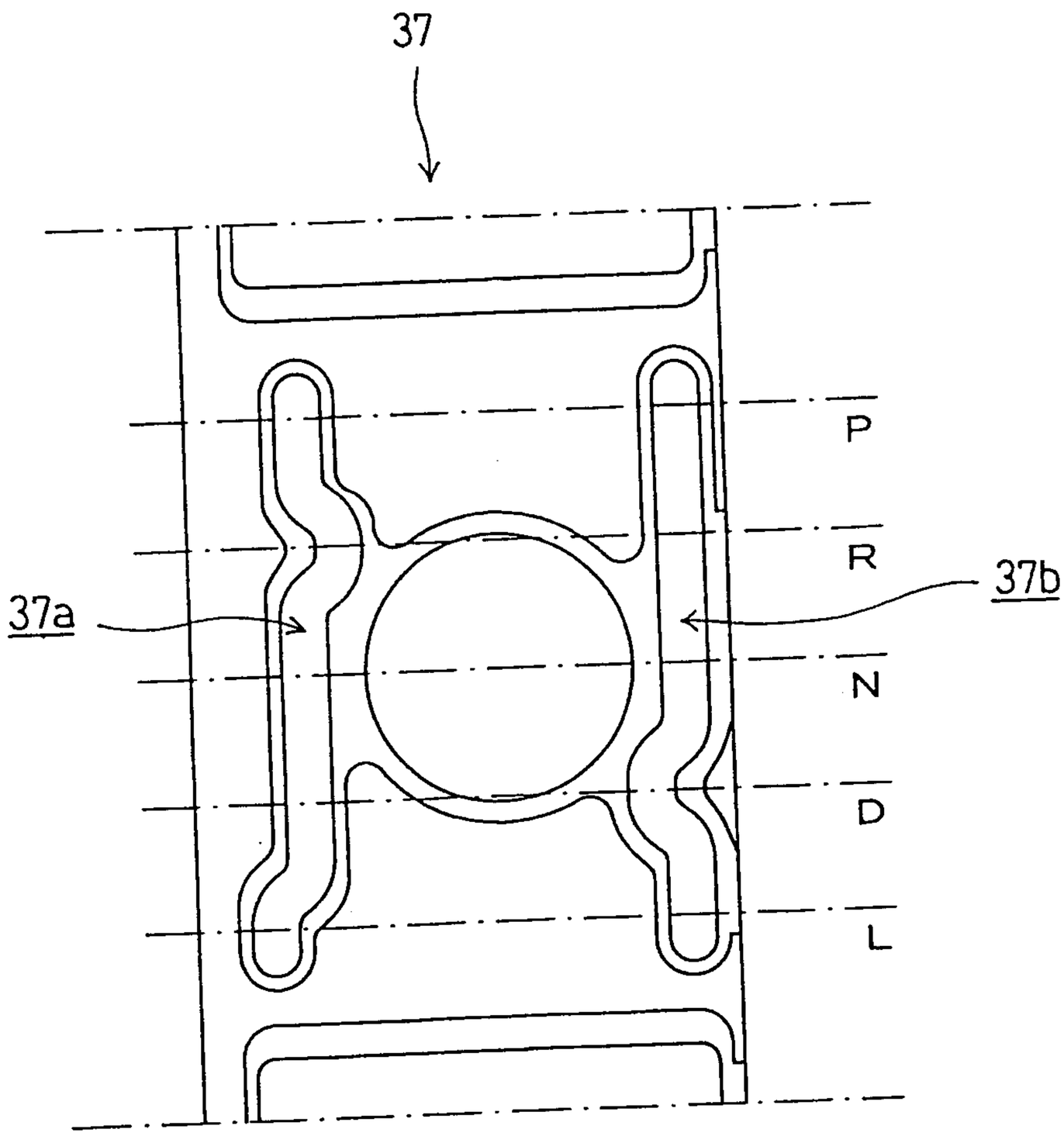

FIG. 8

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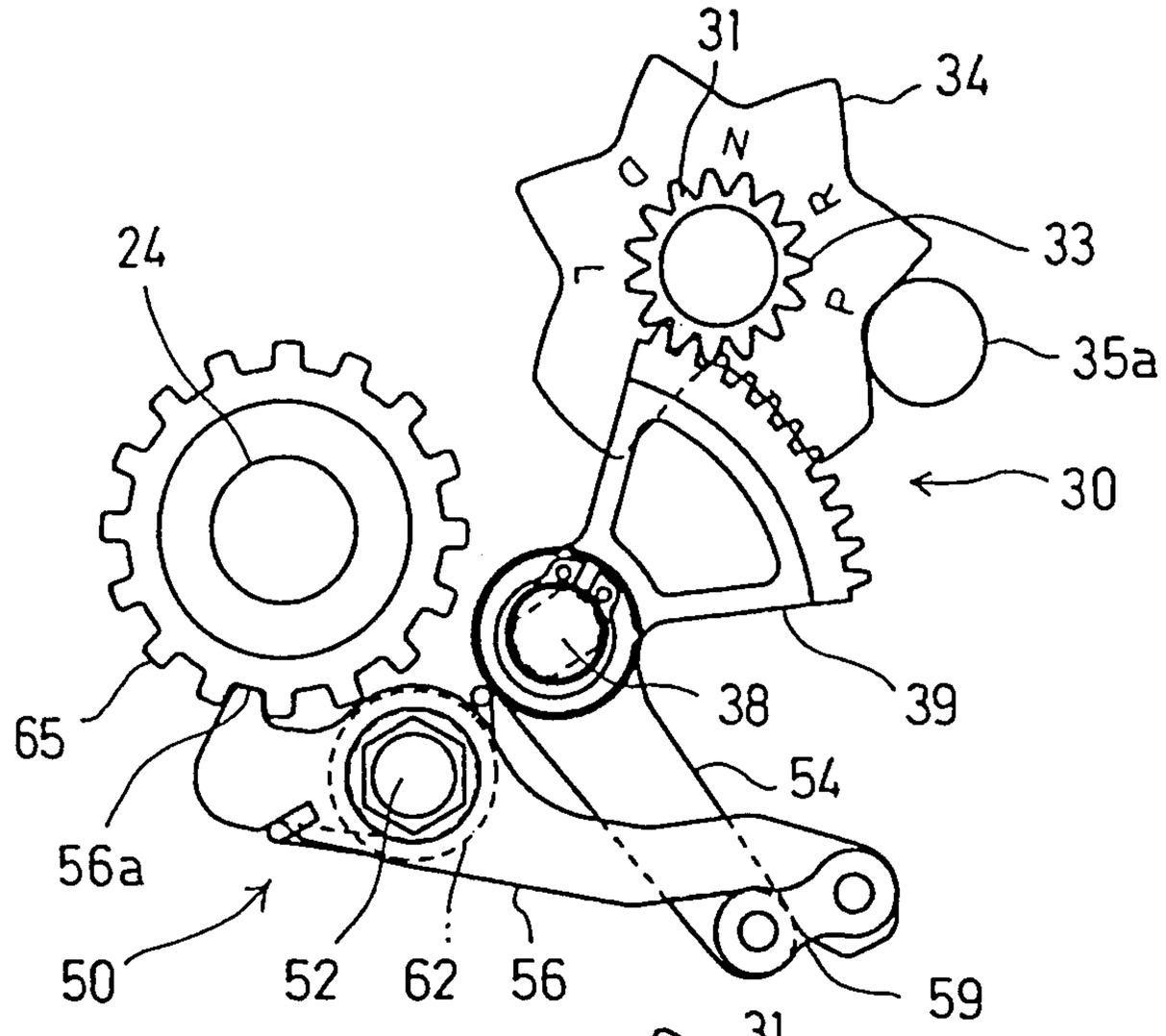
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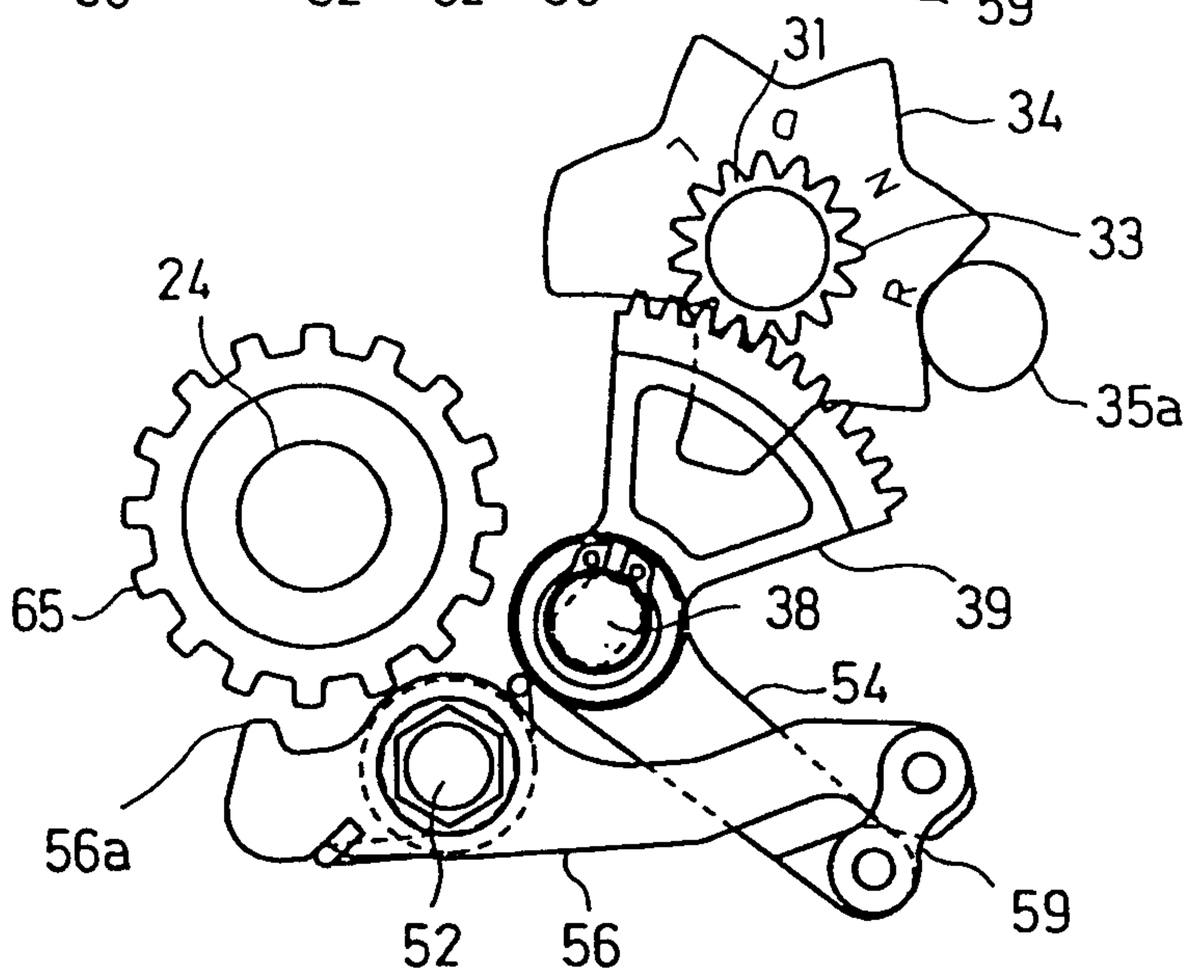
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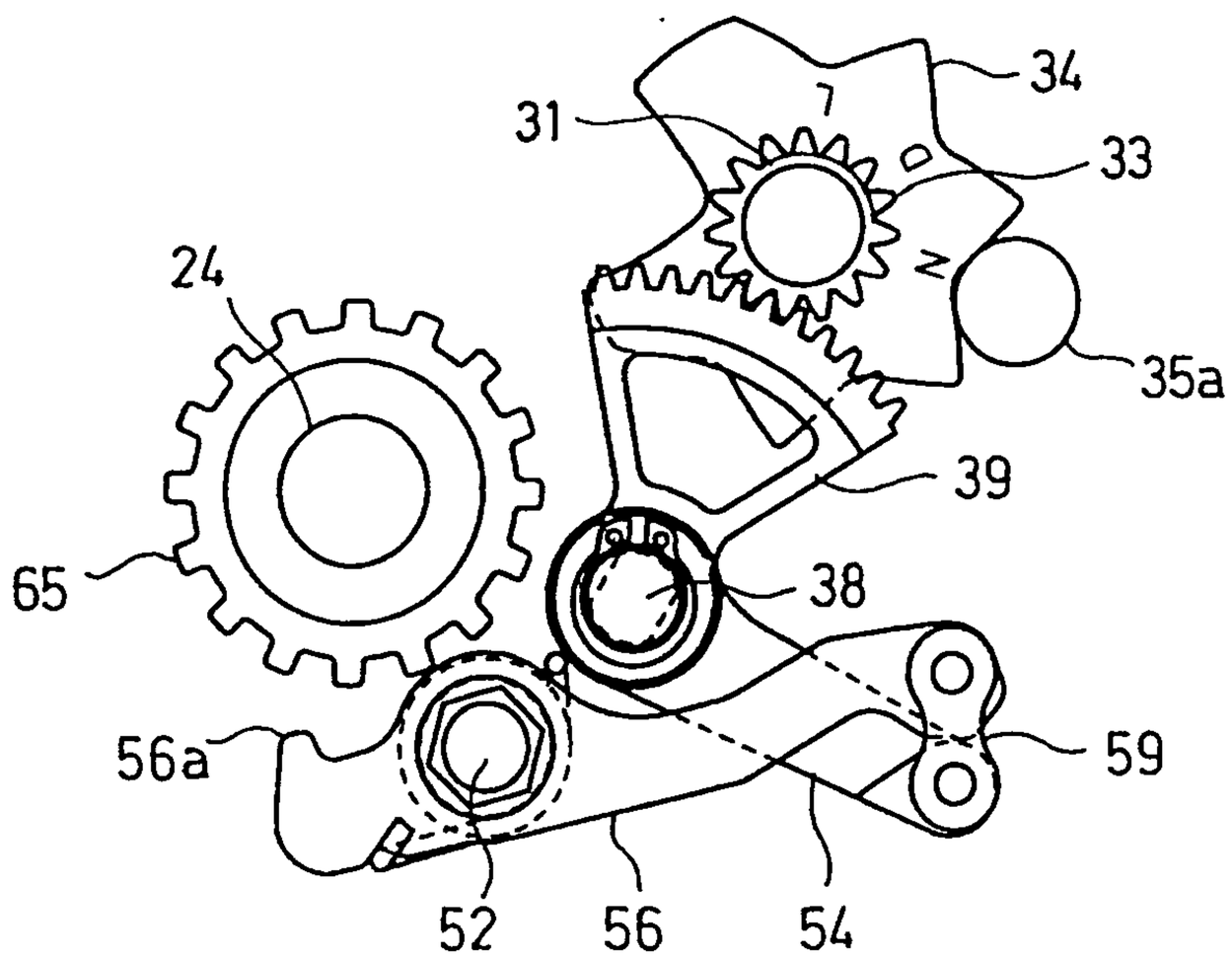
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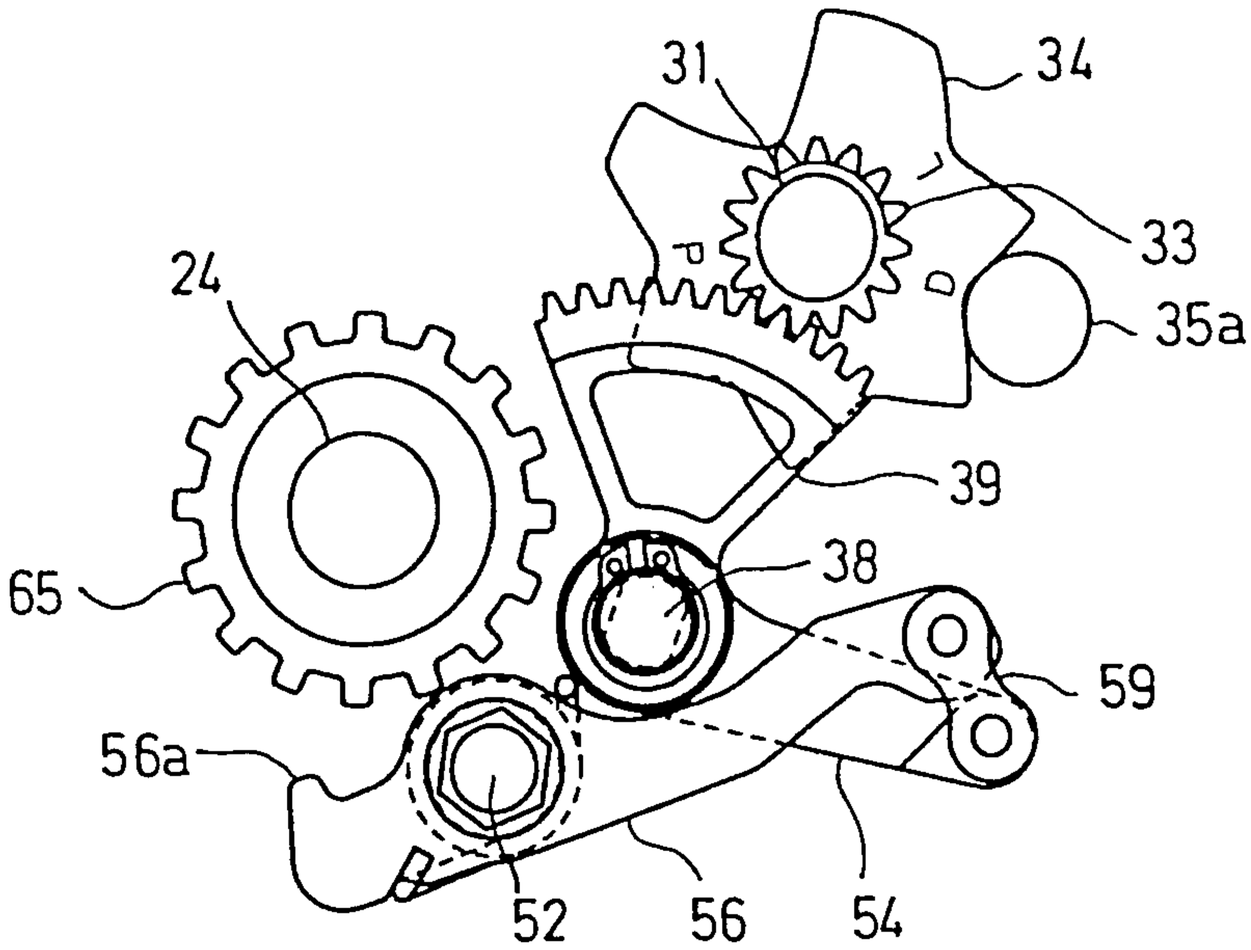
FIG. 9

(4)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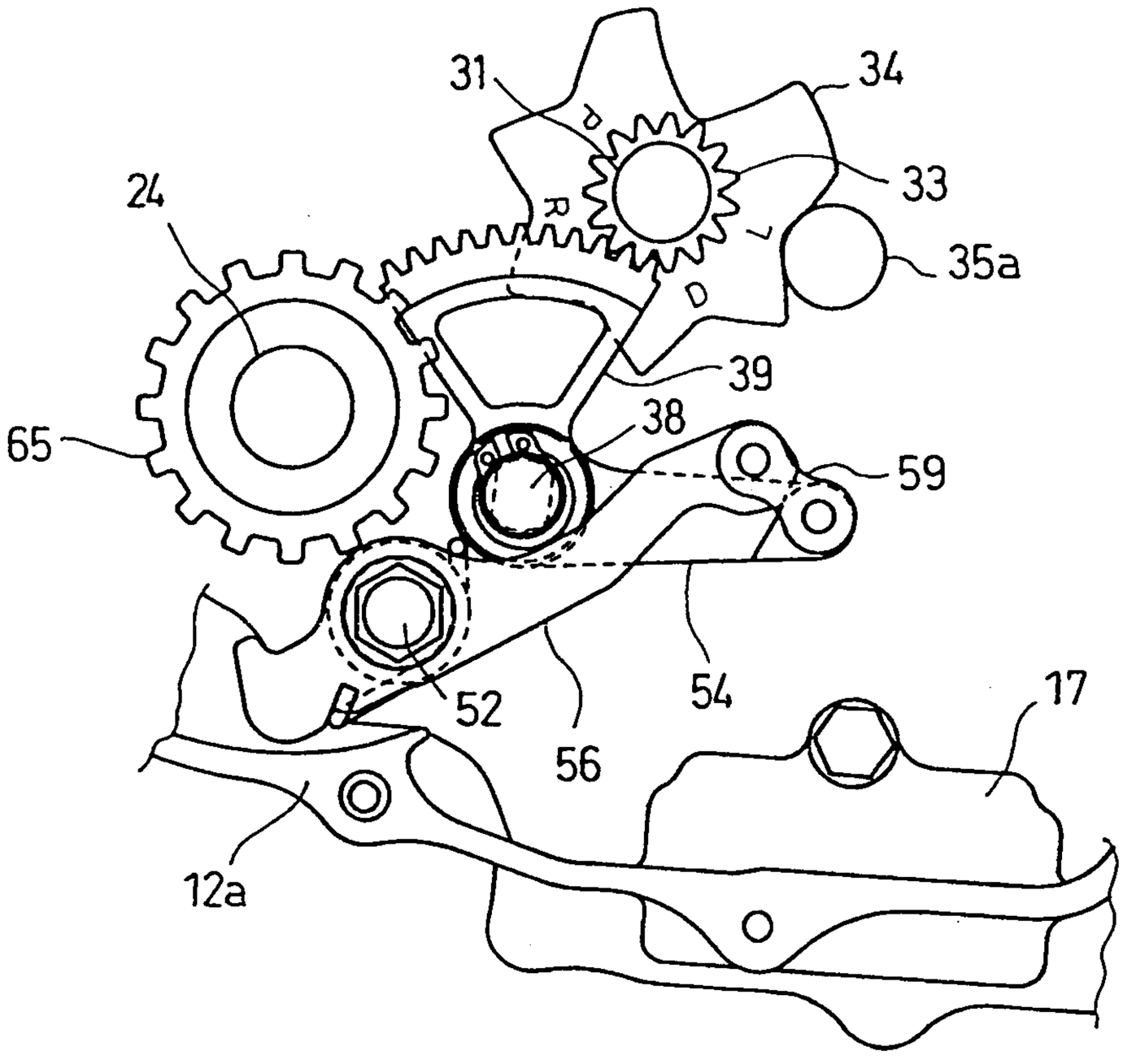
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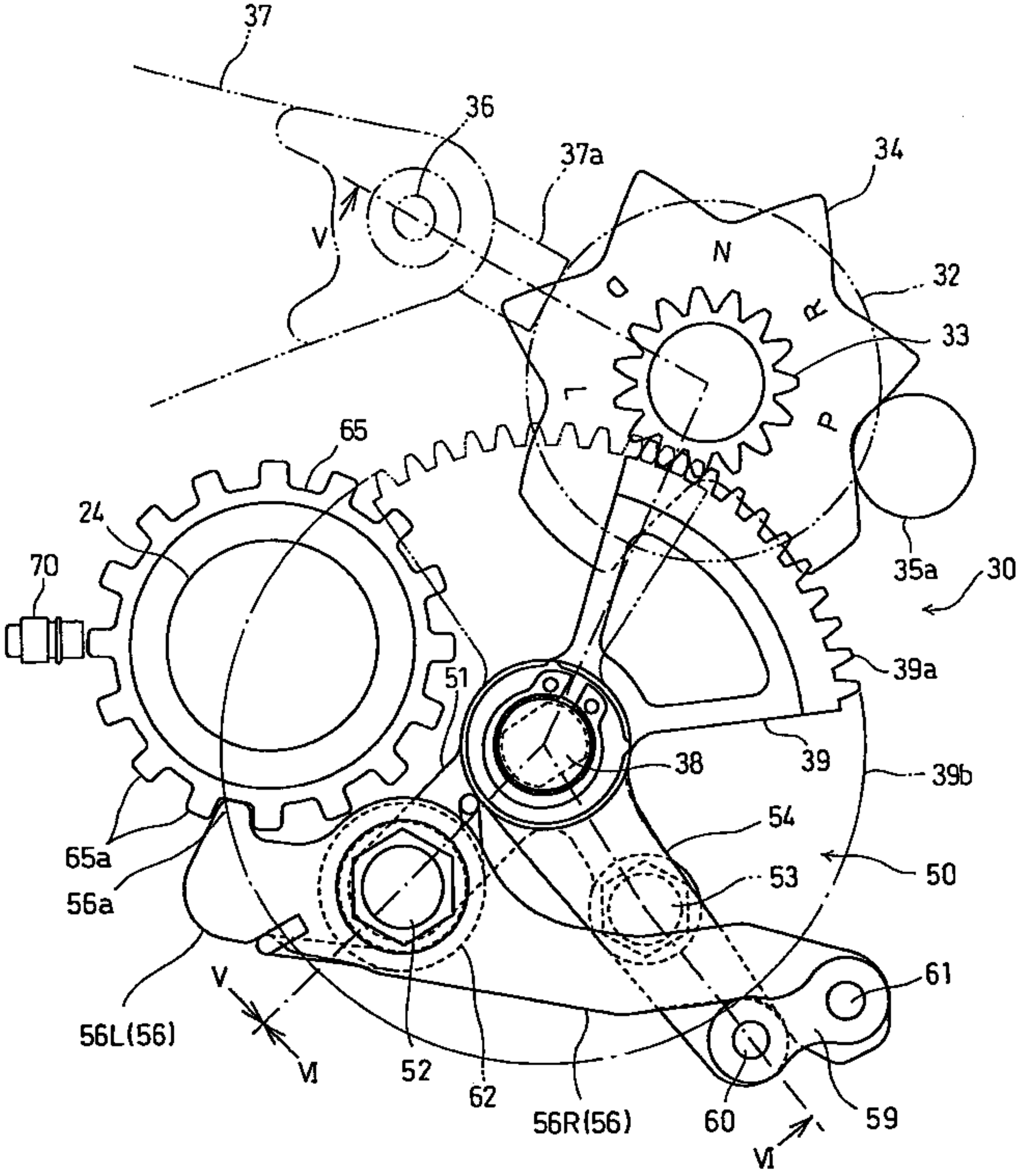
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