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(54) Titre : APPAREIL DE DEMARRAGE DE MOTEUR POUR VEHICULE TOUT TERRAIN
(54) Title: ENGINE STARTING APPARATUS FOR ALL-TERRAIN TRAVELING VEHICLE

(57) Abrégé/Abstract:
To start an engine quickly even when a gear of a transmission is at the forward gear position. A CPU 213 detects the gear position of the transmission based on a gear position control signal S GPC generated by a shift switch and a diode box, and when the gear position is at the neutral position or the forward gear position, enables the engine to start according to a start command operation in a state in which a crankshaft and the transmission are disconnected by a centrifugal clutch.

ABSTRACT OF THE DISCLOSURE

To start an engine quickly even when a gear of a transmission is at the forward gear position. A CPU 213 detects the gear position of the transmission based on a gear position control signal S GPC generated by a shift switch and a diode box, and when the gear position is at the neutral position or the forward gear position, enables the engine to start according to a start command operation in a state in which a crankshaft and the transmission are disconnected by a centrifugal clutch.

ENGINE STARTING APPARATUS FOR ALL-TERRAIN TRAVELING VEHICLE

FIELD OF THE INVENTION

The present invention relates to an engine starting apparatus in an all-terrain traveling vehicle which connects and disconnects a crankshaft of an engine and a transmission by a centrifugal-type clutch, and starting the engine according to an engine start command operation.

BACKGROUND OF THE INVENTION

For example, in a motor vehicle, an engine is generally started according to an engine start command in a state in which the position of a gear of a transmission is neutral, and the engine is adapted not to be started in a state in which the position of the gear of the transmission is at a position other than neutral (for example, JP-A-5-209584)

However, in an all-terrain traveling vehicle, since it travels on a rough road surface, a function to start the engine quickly, for example, even when the engine is stopped while it travels forward on a steep uphill is required. In other words, it is desired that the engine can be started even when the gear position of the transmission is in the forward gear position.

Accordingly, it is an object of the present invention to provide an engine starting apparatus for an all-terrain traveling vehicle in which the engine can be started quickly even when the gear position of the transmission is in the forward gear position.

SUMMARY OF THE INVENTION

In order to solve the problem described above, an engine starting apparatus for an all-terrain traveling vehicle in which an engine is started by the engine start command operation includes a centrifugal clutch for transmitting a rotational force of a crankshaft to a transmission by the number of revolution of the crankshaft of the engine reaches a predetermined number of revolution, a gear position detecting unit for detecting the gear position of the transmission and a controller which enables the engine to start according to the start command operation in a state in which the crankshaft and the transmission are disconnected by the centrifugal clutch when the gear position is at the neutral position and the forward gear position based on the result of detection of the gear position detecting unit.

In this arrangement, the gear position detecting unit detects the gear position of the transmission.

The controller enables the engine to start according to the start command operation in the state in which the crankshaft and the transmission are disconnected by the centrifugal clutch when the gear position is at the neutral position and the forward gear position based on the result of detection of the gear position detecting unit.

In this case, the controller may be adapted to start the engine according to the start command operation when the gear position is the forward gear position, a brake is operated, and a stop switch is in the closed state.

Alternatively, the controller may be adapted to prohibit the engine start when the gear position detected by the gear position detecting unit is the reverse gear position.

Furthermore, the gear position detecting unit may include a shift switch having a plurality of contact points opened and closed according to the gear position of the transmission and a diode box having a plurality of diodes which are electrically connected to the contact points and cause a gear position detection signal to be branched off to an engine start control signal and a gear position display signal in the subsequent stage of the

diode in cooperation with the shift switch, together with producing the gear position signal.

According to the present invention, even though the gear position of the transmission is at the forward gear position, the engine can be started quickly. Also, the gear position detection signal can be branched off to the engine start control signal and the gear position display signal with a simple circuit structure, and the inverse current can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 is a side view of an ATV according to an embodiment of the present invention.

Fig. 2 is a front view of the ATV.

Fig. 3 is an upper view of the ATV.

Fig. 4 is a back view of the ATV.

Fig. 5 is a cross-sectional view of an engine.

Fig. 6 is a side view of the engine, partly in cross-section.

Fig. 7 is a side view of the engine, partly in cross-section.

Fig. 8 is a perspective view of a crankcase.

Fig. 9 is a constitutional explanatory drawing showing an electric system of the ATV.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, the preferred embodiment of the present invention will be described.

Fig. 1 is a side view of an ATV according to an embodiment of the present invention. Fig. 2, Fig. 3 and Fig. 4 are a front view, a top view, and a back view of the ATV respectively.

An ATV 10 is a four-wheel drive vehicle categorized in an ATV (All Terrain Vehicle), which is suitable for agriculture, cattle breeding, hunting, transportation for security monitoring, or leisure. The ATV 10 includes a vehicle frame 11. An engine 12 is supported at the center of the vehicle frame 11, a saddle-type seat 13 is supported above the engine 12, a fuel tank 14 is supported in front of the saddle-type seat 13, and a bar-shaped handle 14A is supported in front thereof. The bar-shaped handle 14A is provided with an accelerator lever 14A1, a brake lever 14A2, and a clutch lever 14A3 mounted thereon.

As shown in Fig. 2, a front wheel 16 is rotatably supported on the vehicle frame 11 via a pair of left and right suspension mechanisms 15. As shown in Fig. 4, a rear swing arm assembly 18 is supported at the rear center of the vehicle frame 11 via a suspension mechanism 17, and a rear wheel 19 is supported by a rear wheel shaft 18A of the rear swing arm assembly 18. A sprocket 18B is fixed to the rear wheel shaft 18A, and as shown in Fig. 1, a drive chain 20 is wound between the sprocket 18B and a final output shaft 27 of the engine 12. A brake mechanism 21 is arranged on the rear wheel shaft 18A. The sprocket 18B and a guard member 18C for protecting the brake mechanism 21 are mounted to the rear swing arm assembly 18.

As shown in Fig. 3, foot rests 22A, 22B for placing the feet are disposed on the left and right sides of the vehicle frame 11, and the foot rests 22A, 22B are positioned between the front wheel 16 and the rear wheel 19. As shown in Fig. 1, the one foot rest 22A is provided with a change pedal 22A1 for switching a transmission ratio of a gear speed change mechanism, described later, so as to be capable of pivotal movement, and the other foot rest 22B is provided with a brake pedal 22B1 for operating the brake mechanism 21 described above so as to be capable of pivotal movement. In addition, as shown in Fig. 1 to Fig. 4, the vehicle frame 11 is provided with a front fender 23A for covering the front wheel 16, a rear fender 23B for covering the rear wheel 19, a front guard 24A, a rear guard 24B, a battery 25, an air cleaner 26, and so on mounted thereto. The rear guard

24B supports an exhaust muffler 28, and supports a storage case 29 having an openable and closable lid 29A.

Fig. 5 is a cross-sectional view of the engine 12 according to this embodiment. The engine 12 is a four-cycle engine, and includes a cylinder head 30, a cylinder block 31, and a crankcase 32. The cylinder block 31 is formed with a cylinder 33, and the cylinder 33 is provided with a piston 34 so as to be capable of sliding movement. The piston 34 is connected to a crankshaft 40 via a connecting rod 35, and the crankshaft 40 is journaled by the crankcase 32.

The cylinder head 30 is provided with an air-intake channel 30A and an exhaust channel 30B, and the respective channels include an air-intake valve 32A and an exhaust valve 32B. These valve bodies are configured to be capable of opening and closing an air-intake port 31A and an exhaust port (not shown) in communication with the cylinder 33. The air-intake valve 32A moves in the vertical direction to open and close the air-intake port 31A according to the cam profile of a cam 33A, while the exhaust valve 32B moves in the vertical direction to open and close the exhaust port (not shown) via a rocker arm 33B driven by the cam 33A.

In other words, as shown in Fig. 6, a sprocket 41 is provided at the shaft end of a camshaft 34A which supports the cam 33A, and a chain 42 is wound between the sprocket 41 and a sprocket 40A fixed to the shaft end of the crankshaft 40. The chain 42 is provided with a tension via a tensioner lifter 42A.

Then, the rotational force of the crankshaft 40 is transmitted to the camshaft 34A via the chain 42, whereby the cam 33A and the locker arm 33B rotate or pivot, and the air-intake valve 32A and the exhaust valve 32B move in the vertical direction, so that the air-intake and exhaust port are opened at a suitable timing according to the rotation of the crankshaft 40.

As shown in Fig. 5, an ignition plug 36 is disposed on the cylinder head 30, and a throttle body and a carburetor, not shown, are connected to the air-intake channel 30A. Combustion air is supplied via the throttle body and

fuel to be mixed with combustion air at a suitable mixture ratio is supplied via the carburetor. Air-fuel mixture is taken into the cylinder 33, and then ignited by the ignition plug 36, whereby an explosive power generated by ignition moves the piston 34 in the vertical direction to rotate the crankshaft 40.

The shaft end of the crankshaft 40 is coaxially provided with an ACG (AC Generator) 43 as shown in Fig. 6. The ACG 43 generates power according to the rotation of the crankshaft 40, and the power is supplied to electric equipment such as an ECU (Electric Control Unit) 201, described later, of the vehicle 10 and the like (see Fig, 9), and is charged in a battery 204 (see Fig, 9).

In addition to the ACG 43, a start clutch 50 including a centrifugal clutch mechanism and a starting gear 60 are coaxially disposed on the crankshaft 40 as shown in Fig. 7. Although not shown, the start clutch 50 mainly includes a clutch inner being connected to the crankshaft 40 and having a clutch shoe, and a clutch outer for connecting the clutch by a frictional force generated when the clutch shoe of the clutch inner is pressed. When the crankshaft 40 rotates, the clutch inner always rotates. When it is rotating at the number of revolution as low as idling, the clutch shoe does not come into press contact with the clutch outer, and hence the clutch inner runs idle. On the other hand, when the number of revolution of the crankshaft 40 exceeds a predetermined value, the clutch shoe of the clutch inner is pressed against the clutch outer by its centrifugal force and hence the clutch is connected.

A primary drive gear 51 is coaxially connected to the clutch outer of the start clutch 50, and when the clutch is connected, the rotational force of the crankshaft 40 is transmitted to the primary drive gear 51 via the start clutch 50.

A primary driven gear 53 engages the primary drive gear 51, and the primary driven gear 53 is disposed coaxially with a main shaft 45 which constitutes part of a constant-mesh gear speed change device described later.

In addition to the start clutch 50, the engine 12 includes a speed-change clutch 70 having a number of frictional plates (not shown) as shown in Fig. 5, and the speed-change clutch 70 is disposed coaxially with the main shaft 45.

The speed-change clutch 70 includes a clutch outer which rotates integrally with the primary driven gear 53 (Fig. 7), a clutch inner rotating integrally with the main shaft 45, the plurality of frictional plates disposed between the clutch outer and the clutch inner, and a clutch piston for pressing the frictional plates, although not shown, respectively. The speed-change clutch 70 moves the clutch piston to connect the clutch by bringing the clutch outer and the clutch inner into press contact with each other via the frictional plates.

In this arrangement, when the start clutch 50 is connected, the rotational force of the crankshaft 40 is transmitted to the primary drive gear 51 and the primary driven gear 53, and then is transmitted to the clutch outer of the speed-change clutch 70 which is connected integrally with the driven gear 53. In this state, if the speed-change clutch 70 is not connected, the clutch outer of the speed-change clutch 70 runs idle, and the rotational force thereof is not transmitted to the main shaft 45. In contrast, when the start clutch 50 is connected, and then the speed-change clutch 70 is connected, the rotational force of the crankshaft 40 is transmitted to the main shaft 45 via the primary drive gear 51, the primary driven gear 53, and the speed-change clutch 70.

In other words, in addition to the crankshaft 40 and the main shaft 45, a counter shaft 46, a shift drum 47, and a shift fork 48 are supported in the crankcase 32 as shown in Fig. 5. These constitute the constant-mesh gear speed change device, and the direction of travel and the transmissionatio are switched among five gears for forward movement and one gear for reverse movement.

In other words, a plurality of gears 45A are connected on the shaft of the main shaft 45, and a plurality of gears 46A engaging the gear 45A of the main shaft 45 are connected on the shaft of the counter shaft 46. Then, by selecting arbitrary gears 45A, 46A and engaging the same with each other,

for example, transmissionatios such as a first speed, a second speed and a third speed are defined, and the rotational force of the main shaft 45 is changed in speed by the gears 45A, 46A and transmitted to the counter shaft 46 according to the defined transmissionatio, then transmitted to the final output shaft 27 connected to the counter shaft 46 via the gear or the like, and then outputted and transmitted to the rear wheel 19 from the final output shaft 27 via the drive chain 20 as a power force of the engine 12 as shown in Fig. 1.

Although not shown, the gear speed change devices 45-48 are provided with a reverse movement speed change gear, and when the reverse movement is selected, the main shaft 45 and the counter shaft 46 are connected via the reverse movement speed change gear. In this arrangement, the rotational force transmitted to the main shaft 45 via two clutch connections is shifted to the reverse movement gear, then transmitted to the final output shaft 27 (Fig. 1) via the counter shaft 46, and then transmitted to the rear wheel 19 from the final output shaft 27 via the drive chain 20 as a power force of the engine 12.

Describing the forward movement speed change operation, connection of the speed-change clutch 70 is released by the operation of the clutch lever 14A3 mounted to the bar-shaped handle 14A, and power transmission to the main shaft 45 is disconnected.

Then, in the state in which power transmission to the main shaft 45 is disconnected, the change pedal 22A1 (Fig. 1) mounted to the foot rest 22A is pivoted. The change pedal 22A1 is connected to the shift drum 47, and when the change pedal 22A1 is pivoted, the shift drum 47 rotates, and the rotation moves a shift pin 48A engaged with a helical groove (not shown) of the shift drum 47 in the axial direction. The shift pin 48A is integral with the shift fork 48, and when the shift pin 48A moves in the axial direction, the shift fork 48 slides in the axial direction, and the shift fork 48 moves any one of the gears 46A on the counter shaft 46 in the axial direction, whereby the gear 46A and any one of the gears 45A on the main shaft 45 are engaged.

In this embodiment, as shown in Fig. 5 to Fig. 7, the engine 12 is provided with a starter motor 100 for starting the engine mounted thereon. The engine 12 is provided with the crankcase 32 as shown in Fig. 8, and the crankcase 32 is integrally molded with a motor mount 101 formed by casting at the front part thereof. The starter motor 100 is cantilevered by the motor mount 101. The crankcase 32 includes a front engine mount 12A for fixing the front side of the engine 12 to the vehicle frame 11, and a lower engine mount 12B for fixing the lower side of the engine 12 to the vehicle frame 11 both molded integrally by casting, and the motor mount 101 is integrally molded between the front engine mount 12A and the lower engine mount 12B.

The motor mount 101 is disposed at a position slightly shifted toward one side surface of the crankcase 32 in the area between the front engine mount 12A and the lower engine mount 12B, and is formed into a shape projecting obliquely forward.

The motor mount 101 is, as shown in Fig. 7, a hollow in the interior thereof, and a pinion gear 103 fixed to a motor shaft 102 of the starter motor 100 is disposed therein. A transmission gear 104A engages the pinion gear 103, and a transmission gear 104B engages a small gear 104C which is integral with the transmission gear 104A, and the transmission gear 104B engages with the starting gear 60 connected to the crankshaft 40. The starting gear 60 is connected to the crankshaft 40 via a one-way clutch (not shown). The gear train described above constitutes a transmission mechanism 105 for transmitting a rotational force of the starter motor 100 to the crankshaft 40.

The one-way clutch (not shown) is a clutch which enables transmission of rotational force of the starting gear 60 to the crankshaft 40 as long as the number of revolution of the starting gear 60 exceeds the number of revolution of the crankshaft 40. Instead of the one-way clutch, it is also possible to apply an electromagnetic pushing mechanism for moving the pinion gear 103 of the starter motor 100 between the position to mesh with the transmission gear 104A and the position not to mesh therewith using, for example, a magnet switch.

In this structure, when the starter motor 100 is started when starting the engine 12, the pinion gear 103 rotates, then the starting gear 60 rotates via the transmission gear 104A, the small gear 104C and the transmission gear 104B, and hence the crankshaft 40 engaged with the starting gear 60 via the one-way clutch (not shown) is driven. At this time, ignition control of the ignition plug 36 is performed by the ECU, not shown, whereby the engine 12 is started.

When the engine 12 is started, the clutch connection of the start clutch 50 is released, and the power is not transmitted from the crankshaft 40 to the primary drive gear 51.

In other words, the engine 12 can be started according to the start command operation in a state in which connection between the crankshaft 40 and the speed-change clutch 70, and hence the constant-mesh gear speed change device are disconnected with the start clutch 50 (centrifugal clutch).

The electric structure of the ATV in the embodiment will be described.

Fig. 9 shows a structure of an electric system of the ATV.

The electric system of the ATV 10 includes the ECU 201 for controlling an ignition system of the engine or the like, the ACG 43 for generating an AC power in association with the rotation of the crankshaft 40, a regulator-rectifier 203 having a three-phase full-wave rectification bridge circuit and a stabilizing circuit, not shown, for rectifying and stabilizing a generated output of the ACG 43, a battery 204 for storing the DC power supplied from an ACG 202 via the regulator-rectifier 203 and supplying the DC power to the respective parts, and an ignition key switch 205 having a plurality of contact points and supplying power, which is supplied via the regulator-rectifier 203 when being closed (ON state) in conjunction with key operation of the rider.

The electric system of the ATV 10 further includes a fuse box 206 provided with a plurality of fuses for preventing excess current from being supplied to the respective parts directly from the regulator-rectifier 203 or from the

regulator-rectifier 203 via the ignition key switch 205, the starter motor 100 which is connected to the battery 204 when a start switch 207 is brought into a closed state by the operation of the rider when starting the engine and the starter magnet switch 208 is driven and brought into the closed state, and rotates the crankshaft 40, a shift switch 210 which is interlocked with the operation of the change pedal 22A1 and hence the position of the shift drum 47, a diode box 211 which is provided with a plurality of reverse current blocking diodes, is interlocked with the shift switch 210, generates a gear position detection signal S GP, branches off the gear position detection signal S GP and outputs as a gear position display signal S GPD and a gear position control signal S GPC (which is equivalent to the engine start control signal), a condition display unit 212 provided with a plurality of LEDs for displaying the various conditions, a CPU 213 for controlling the entire ATV 10, a lamp/horn unit 214 for turning on and off various lamps such as a front lamp and driving an alarm unit (horn) under control of the CPU 231, and a stop switch 215 which is interlocked with the operation of the brake.

In the structure described above, the ECU 201 is connected to a throttle sensor 221 for detecting the throttle opening, a fan motor 222 for driving a radiator fan, a kill switch 223 for stopping the engine in case of emergency, a pulse generator 224 for generating pulses which corresponds to the reference ignition timing, a cooling water temperature sensor 225 for detecting the temperature of cooling water, an ignition coil 226 for generating a high voltage for igniting the engine, a rotor angle sensor 227 for detecting the rotor angle, and hence the crank angle of the ACG 43, and a fuel sensor 228 for detecting the amount of fuel.

The shift switch 210 is a change-over switch including seven contact points and one movable section, and the contact points correspond to a forward first gear, a forward second gear, a forward third gear, a forward fourth gear, a forward fifth gear, a reverse gear, and the neutral position, respectively.

The diode box 211 includes six diodes DN, D1-D5, which correspond to the gear positions; the neutral position, the forward first gear, the forward

second gear, the forward third gear, the forward fourth gear, the forward fifth gear, respectively.

Here, the electric connection among the ECU 201, the seven contact points constituting the shift switch 210, the diodes constituting the diode box 211 and the CPU will be described in detail.

The ECU 201 includes a stop switch terminal 201A which is connected to the stop switch 215 and serves as a current supply terminal for generating a gear position detection signal, and an anode terminal of the diode DN which constitutes the diode box 211 is directly connected to the stop switch terminal 201A. Anode terminals of the diodes D1-D5 are commonly connected also to the stop switch terminal 201A via the stop switch 215.

A cathode terminal of the diode DN is connected to a neutral detection terminal TN of the ECU 201 and a corresponding contact point of the shift switch 210. In the same manner, the cathode terminals of the diodes D1-D5 are connected to a gear position display input terminal of the ECU 201 and corresponding contact points of the shift switches 210. The respective cathode terminals of the diodes D1-D5 are connected to the CPU 213.

The contact point corresponding to the reverse movement which constitutes the shift switch 210 is connected to a reverse movement detection terminal of the ECU 201, and is connected to the regulator-rectifier 203 via the LED which constitutes the condition display unit 212, the fuse box 206, and the ignition switch 205.

Connected between the CPU 213 and the ECU 201 is a control line LC which is used by the CPU 213 for controlling the ECU 201.

In the description below, the output signals from the diodes D1-D5 constituting the diode box 211 are referred to as the gear position detection signal S GP for the sake of convenience, the signal which is branched off from the gear position detection signal S GP in the diode box 211 and reaches the gear position display input terminal of the ECU 201 is referred to as the gear position display signal S GPD, and the signal which is branched off from the gear position detection signal S GP in the diode box

211 and reaches the CPU 213 is referred to as the gear position control signal S GPC.

Subsequently, the engine ignition control operation will be described.

When the kill switch 223 is in the closed state (ON state), the rider inserts the key, and then the ignition switch 205 is turned ON in association with the key operation.

When the rider operates the start switch 207 to the closed state (ON state) in this state, the starter magnet switch 208 is driven and brought into the closed state ,so that the starter motor 100 is connected to the battery 204.

Consequently, the starter motor 100 is driven, the pinion gear 103 rotates, the start gear 60 rotates via the transmission gear 104A, a small gear 104C and the transmission gear 104B, and the crankshaft 40 which is integral therewith is rotated at a number of revolution smaller than the number of idling revolution.

In this state, the CPU 213 controls ignition.

The control of the CPU 213 will now be described in detail.

(1) When the gear is at the neutral position.

When the shift drum 47 is in a state corresponding to the neutral position of the gear by the operation of the change pedal 22A1 by the rider, the movable section constituting the shift switch 210 is electrically connected to the contact point corresponding to the neutral position (shown by N in the drawing) out of the seven contact points.

Consequently, the cathode terminal of the diode DN is connected to an engine earth EE and a frame earth FE having the same potential (which is equivalent to "L" level) via the corresponding contact point of the shift switch 210.

Therefore, a current is supplied from the stop switch terminal 201A of the ECU 201 to the diode DN, and the current flows through the engine earth EE and the frame earth FE, and hence the potential level at the cathode terminal of the diode DN becomes "L" level (which is equivalent to the potential level of the engine earth and the frame earth FE).

Accordingly, the neutral detection terminal TN of the ECU 201 also becomes "L" level, and the ECU 201 determines that the engine start conditions are satisfied without waiting for the control of the CPU 213.

Therefore, the ECU 201 which determines that the engine start conditions are satisfied controls the ignition coil 226 based on the pulse corresponding to the reference ignition timing generated by the pulse generator 224 and the crank angle corresponding to the output of the rotor angle sensor 227, and applies a high voltage for ignition to the ignition plug 36 connected to the secondary side of the ignition coil 226.

Accordingly, discharge between a center electrode and a ground electrode of the ignition plug 36 is effected, so that air-fuel mixture supplied to a cylinder via a carburetor, not shown, is ignited, thereby completing the engine start.

When the engine 12 is started, the number of revolution of the crankshaft 40 increases to the number of idling revolution. The starting gear 60 is provided on the crankshaft 40 via a one-way clutch, and hence when the number of revolution of the starting gear 60 exceeds the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are connected, and when the number of revolution of the starting gear 60 runs under the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are disconnected, whereby the starting gear 60 runs idle. Therefore, even when the engine 12 is started, since the number of revolution of the starting gear 60 runs under the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are disconnected after having started the engine. Therefore, when the starter motor 100 is driven after having started the engine, the respective gears 103, 104A, 104B, and 60 of the transmission mechanism 105 run idle.

When the engine 12 starts, the clutch connection of the start clutch 50 is released, and hence the power is not transmitted from the crankshaft 40 to the primary drive gear 51.

In other words, the start clutch 50 which serves as a centrifugal clutch can start the engine in a state in which connection between the crankshaft 40 and the aforementioned speed-change clutch 70, and hence the connection with the aforementioned constant-mesh gear speed change device (transmission) is disconnected.

(2) When the gear is at any one of the forward first gear to the forward fifth gear.

When the shift drum 47 is under the condition corresponding to the forward first gear to the forward fifth gear of the gear by the operation of the change pedal 22A1 by the rider, the movable section which constitutes the shift switch 210 is electrically connected to the contact point which corresponds to any one of the forward first gear to the forward fifth gear (shown by 1 to 5 in the drawing) out of the seven contact points.

Consequently, the cathode terminals of the diodes DX (X=1-5) corresponding to the forward gear position are connected to the engine earth EE and the frame earth FE having the same potential via the corresponding contact points and the movable section of the shift switch 210.

Therefore, the current is supplied from the stop switch terminal 201A of the ECU 201 via the stop switch 215 to the diode DX, and the current flows to the engine earth EE and the frame earth FE, and hence the potential level of the cathode terminal of the diode DX becomes "L" level (which is equivalent to the potential level of the engine earth and the frame earth FE). In other words, gear position detection signals S GPX (X=1-5) corresponding to the forward gear positions are at "L" level, and gear position display signals S GPDX (X=1-5) and gear position control signals S GPCX (X=1-5) branched off therefrom are also at "L" level.

At this time, since the cathode terminals of the diodes DY (Y=1-5, and Y≠X) which correspond to the unselected forward gear positions are not connected to the engine earth EE and the frame earth FE, the corresponding gear position detection signals S GPY (Y=1-5, and Y≠X) become "H" level (which is equivalent to the potential level of the stop switch terminal 201A of the ECU 201, more precisely, the potential level of the stop switch terminal 201A in which the amount of voltage drop of the diode is taken into account), and hence gear position display signals S GPDY (Y=1-5, and Y≠X) and gear position control signals S GPCY (Y=1-5 and Y≠X) branched off therefrom are also at "H" level.

More specifically, when the shift drum 47 is in the state corresponding to a forward third gear position by the operation of the change pedal 22A1, a gear position detection signal S GP3 becomes "L" level, and a gear position display signal S GPD3 and a gear position control signal S GPC3 branched off therefrom are also at the "L" level. On the other hand, gear position detection signals S GP1, S GP2, S GP4, S GP5 are at "H" level, and gear position display signals S GPD1, S GPD2, S GPD4, S GPD5 which are branched off and outputted to the ECU 201 and gear position control signals S GPC1, S GPC2, S GPC4, S GPC5 which are outputted to the CPU 213 are also at "H" level.

Consequently, when only one of the gear position control signals S GPCX (X=1-5) the CPU 213 becomes "L" level, it is determined that the gear position is the forward gear position, and the brake is being applied, and hence an instruction to permit ignition is sent to the ECU 201 via the control line LC.

Accordingly, the ECU 201 controls the ignition coil 226 based on the pulse corresponding to the reference ignition timing generated by the pulse generator 224 and on the crank angle corresponding to the output of the rotor angle sensor 227, and applies a high voltage for ignition to the ignition plug 36 connected to the secondary side of the ignition coil 226.

Accordingly, discharge between the center electrode and the earth electrode of the ignition plug 36 is effected, and air-fuel mixture supplied

into the cylinder via a carburetor, not shown, is ignited, thereby completing the engine start.

When the engine 12 starts, the number of revolution of the crankshaft 40 increases to the number of idling revolution. The starting gear 60 is provided on the crankshaft 40 via the one-way clutch, and hence when the number of revolution of the starting gear 60 exceeds the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are connected, and when the number of revolution of the starting gear 60 runs under the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are disconnected and the starting gear 60 runs idle. Therefore, even when the engine 12 starts, since the number of revolution of the starting gear 60 runs under the number of revolution of the crankshaft 40, the starting gear 60 and the crankshaft 40 are disconnected after having started the engine. Therefore, when the starter motor 100 is driven after having started the engine, the respective gears 103, 104A, 104B, 60 of the transmission mechanism 105 run idle.

When the engine 12 starts, the clutch connection of the start clutch 50 is released, and the power is not transmitted from the crankshaft 40 to the primary drive gear 51.

In other words, the start clutch 50 which functions as a centrifugal clutch can start the engine in a state in which the crankshaft 40 and the aforementioned speed-change clutch 70, and hence the aforementioned constant-mesh gear speed change device (transmission) are disconnected.

In other words, when the gear position is at the forward gear position and the brake is operated to bring the stop switch into the closed state (ON state), the engine can be started immediately. Therefore, even when the engine is stopped while climbing the uphill, the vehicle can be started again easily and quickly without sudden acceleration.

On the other hand, since only the gear position display signal S GPD3 out of the input gear position display signals S GPD is at the "L" level, the ECU 201 turns on a gear position display lamp, which corresponds to the

forward third gear, not shown, to notify the rider that the gear is now at the forward third gear position.

In contrast to the above-described operation, when all the gear position control signals S GPCX (X=1-5) are in the high-impedance state, the CPU 213 determines that the stop switch 215 is in the opened state (OFF state), and the brake is not applied, and hence sends an instruction to prohibit ignition except for the case where the gear is at the neutral position to the ECU 201 via the control line LC.

When all the gear position control signals S GPCX (X=1-5) are at the "H" level, the CPU 213 determines that the brake is operated, but the gear is not at the forward gear position.

(3) When the gear is at the reverse position.

When the shift drum 47 is in a state corresponding to the reverse position of the gear by the operation of the change pedal 22A1 of the rider, the movable section which constitutes the shift switch 210 is electrically connected to the contact point which corresponds to the reverse position (represented by R in the drawing) out of the seven contact points.

Consequently, a reverse movement detection terminal TR of the ECU 201 is connected to the engine earth EE and the frame earth FE via the shift switch 210, and the potential level of the reverse movement detection terminal TR becomes "L" level (which is equivalent to the potential level of the engine earth and the frame earth FE).

Therefore, the ECU 201 determines that the engine start conditions are not satisfied without waiting for the control of the CPU 213, and goes into a waiting state, in which the ignition is prohibited.

As described thus far, according to this embodiment, when the engine stops, the engine can be started easily and quickly in a state in which the crankshaft and the transmission are disconnected by the centrifugal clutch when the gear is at the neutral position and the forward gear position (in the example described above, the forward first to fifth gears).

Although description has been made regarding the speed change device having five forward gears and one reverse gear thus far, the invention is not limited thereto, and the speed change device having the arbitrary number of gears is applicable.

Although description has been made regarding the case in which the gear is at the position corresponding to the case where the gear position detection signal S GP, the gear position display signal S GPD, and the gear position control signal S GPC are at "L" level, the invention is not limited thereto, and the circuit can be configured to cause the gear to be at the position corresponding to the case in which the gear position detection signal S GP, the gear position display signal S GPD, and the gear position control signal S GPC are at "H" level.

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. An engine starting apparatus for an all-terrain traveling vehicle in which an engine is started by an engine start command operation comprising: a centrifugal clutch for transmitting a rotational force of a crankshaft to a transmission when the rotary speed of the crankshaft of the engine reaches a predetermined threshold value; a gear position sensor for detecting a gear position of the transmission having forward gears and a reverse gear; and a controller which enables starting of the engine according to the start command operation when the crankshaft and the transmission are disconnected by the centrifugal clutch and when the gear position is at one of a neutral position and a forward gear position based on the gear position detected by the gear position sensor.

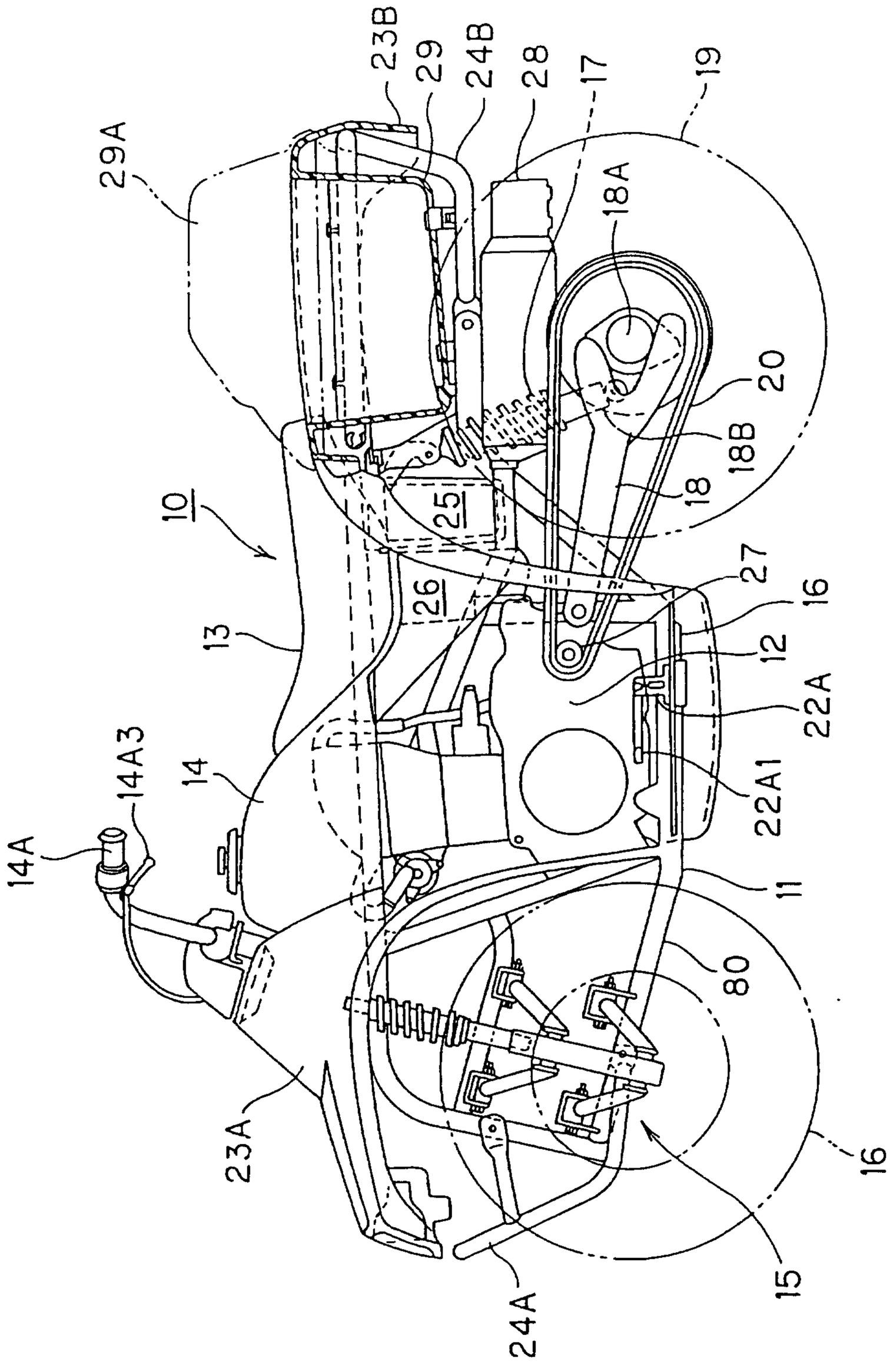
2. The engine starting apparatus for an all-terrain traveling vehicle according to Claim 1, characterized in that the controller is adapted to start the engine according to the start command operation when the gear position is the forward gear position, a brake is operated, and a stop switch is in the closed state.

3. The engine starting apparatus for an all-terrain traveling vehicle according to Claim 1 or Claim 2, characterized in that the controller is adapted to prohibit the engine start when the gear position detected by the gear position sensor is the reverse gear position.

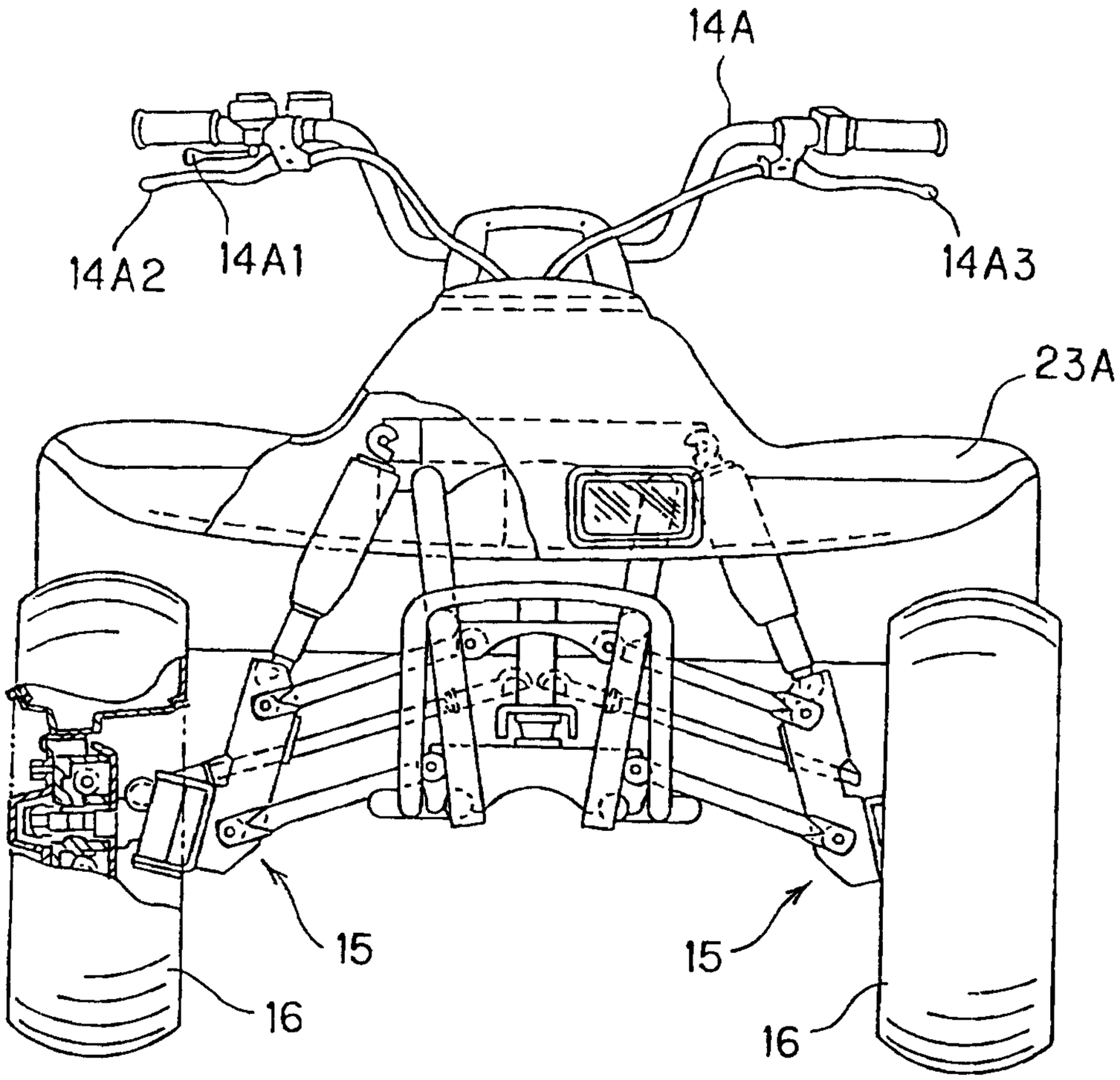
4. The engine starting apparatus for an all-terrain traveling vehicle according to any one of Claims 1 to 3, characterized in that the gear position sensor comprises: a shift switch having a plurality of contact points opened and closed according to the gear position of the transmission and a diode box having a plurality of diodes which are electrically connected to the contact points and in cooperation with the shift switch, produces a gear position detection signal, the diode box causing said gear position detection signal to branch into an engine start control signal and a gear position display signal.

[Name of Document] Drawings

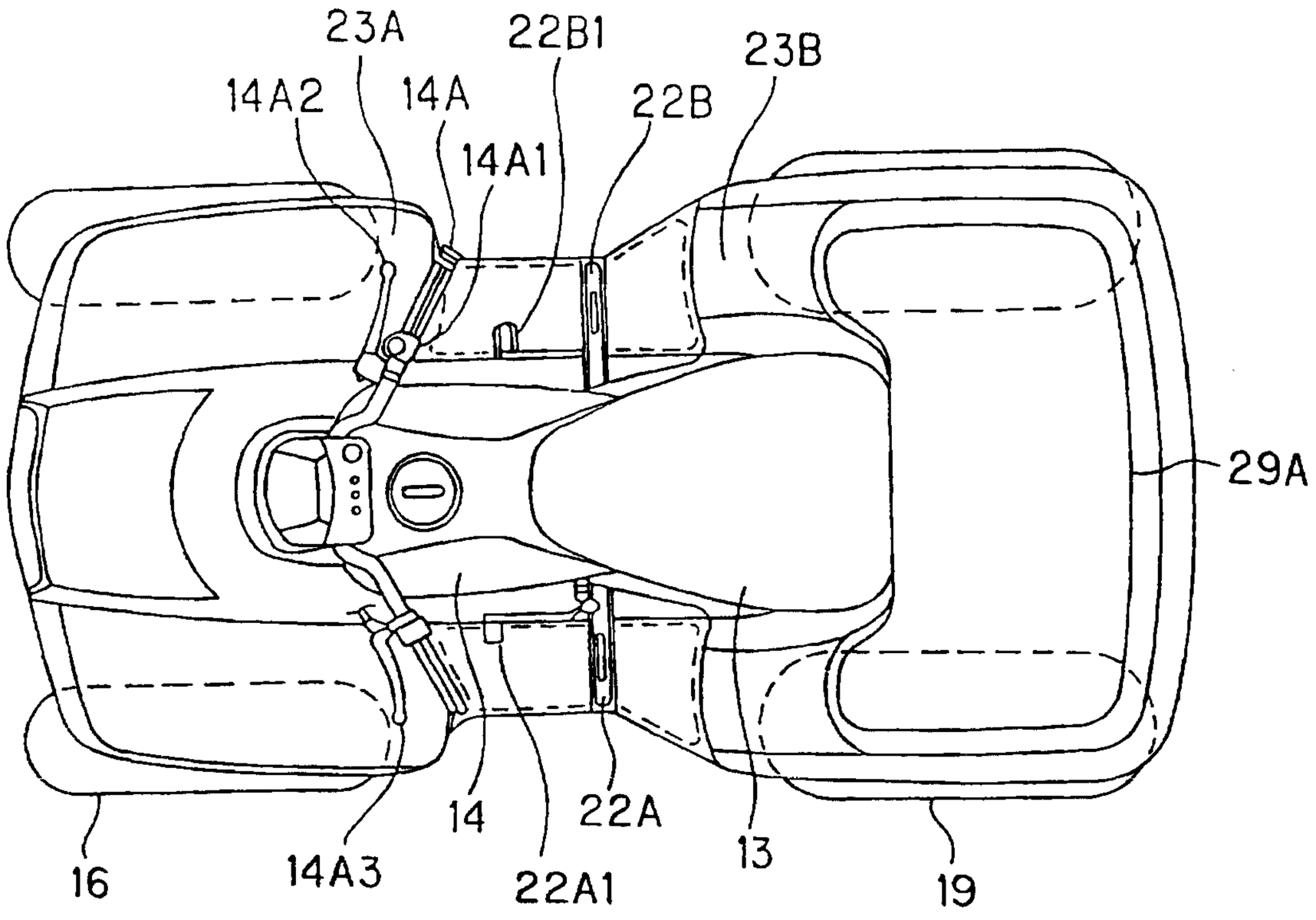
[Fig.1]



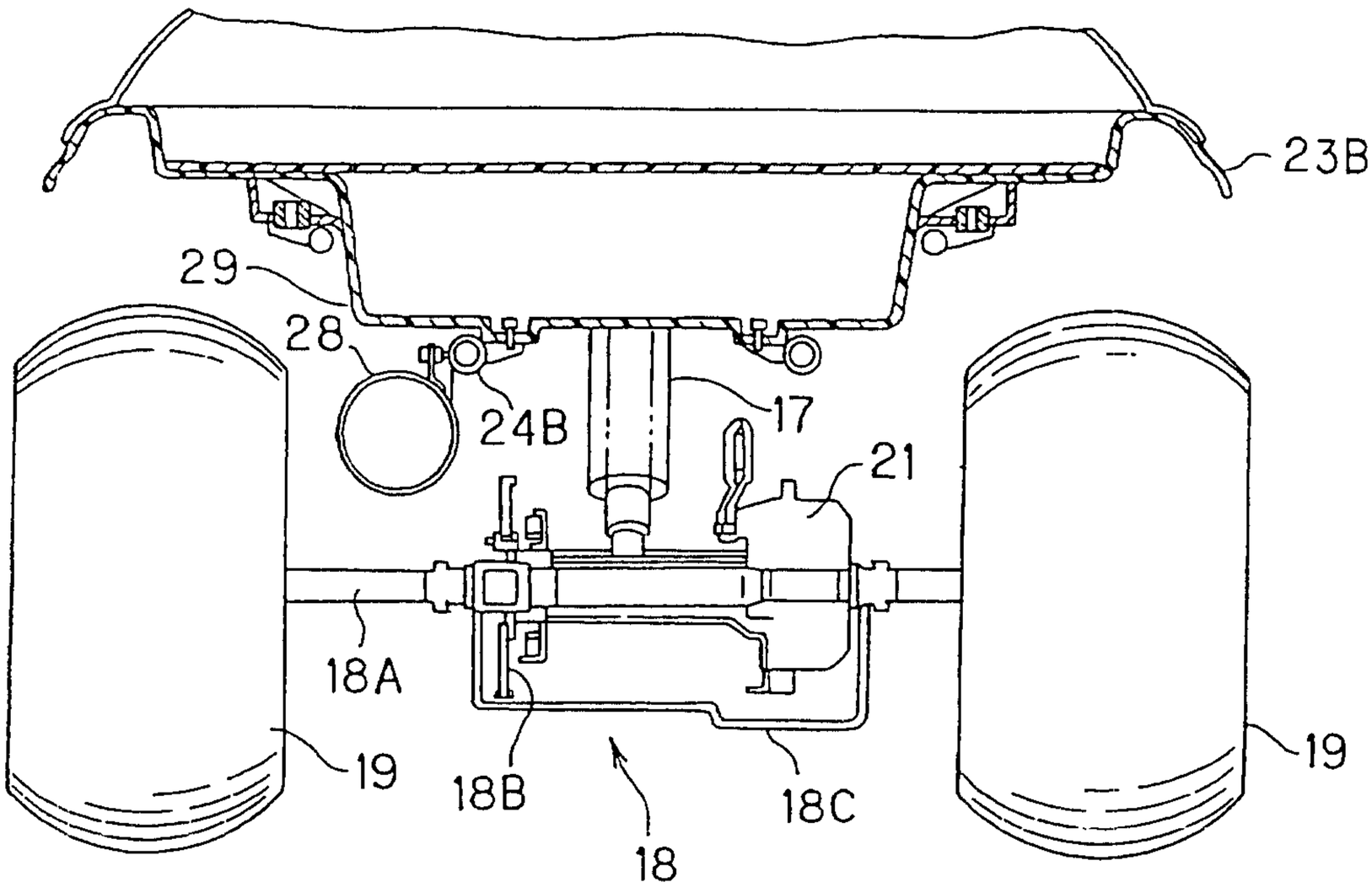
[Fig.2]



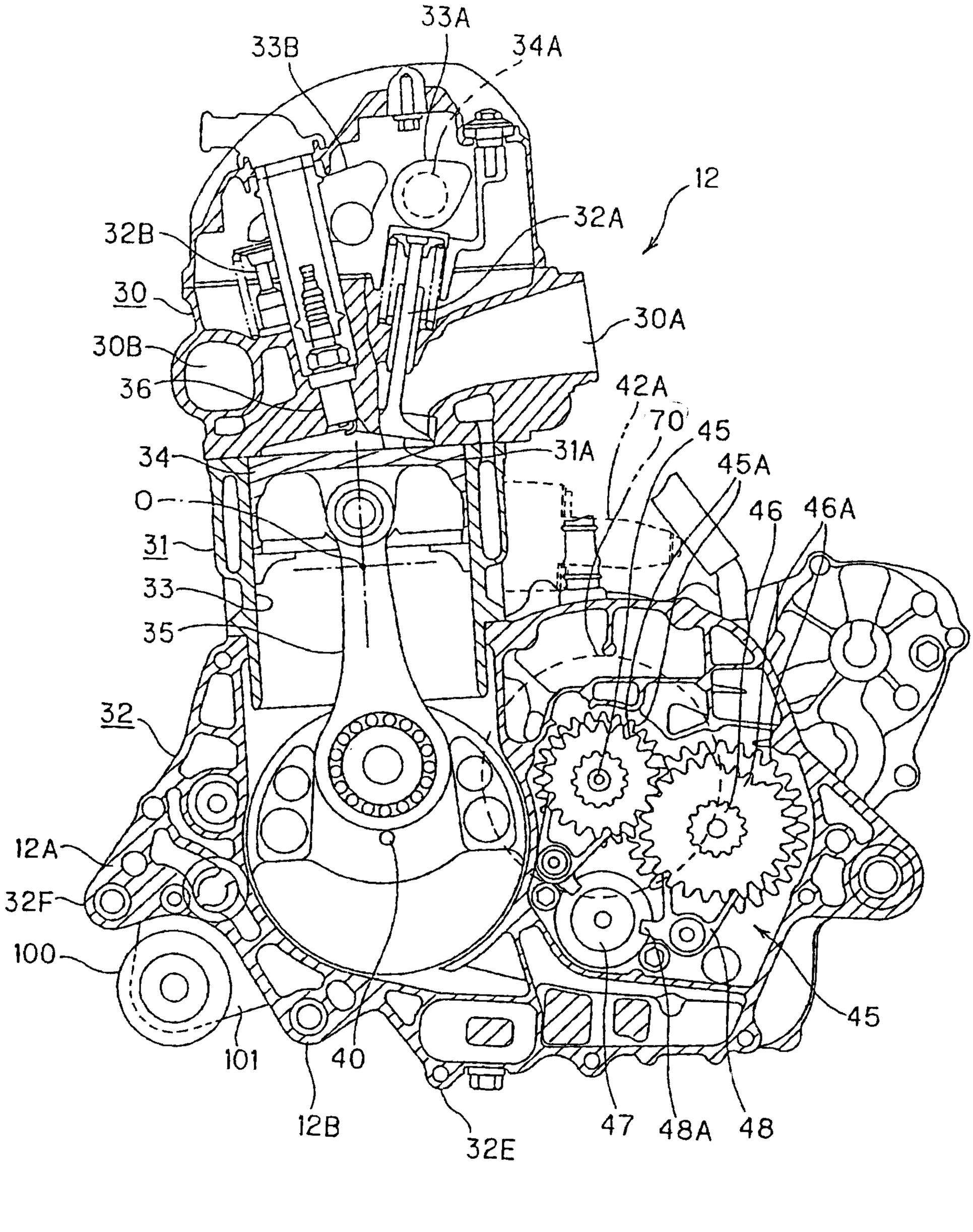
[Fig.3]



[Fig.4]



[Fig.5]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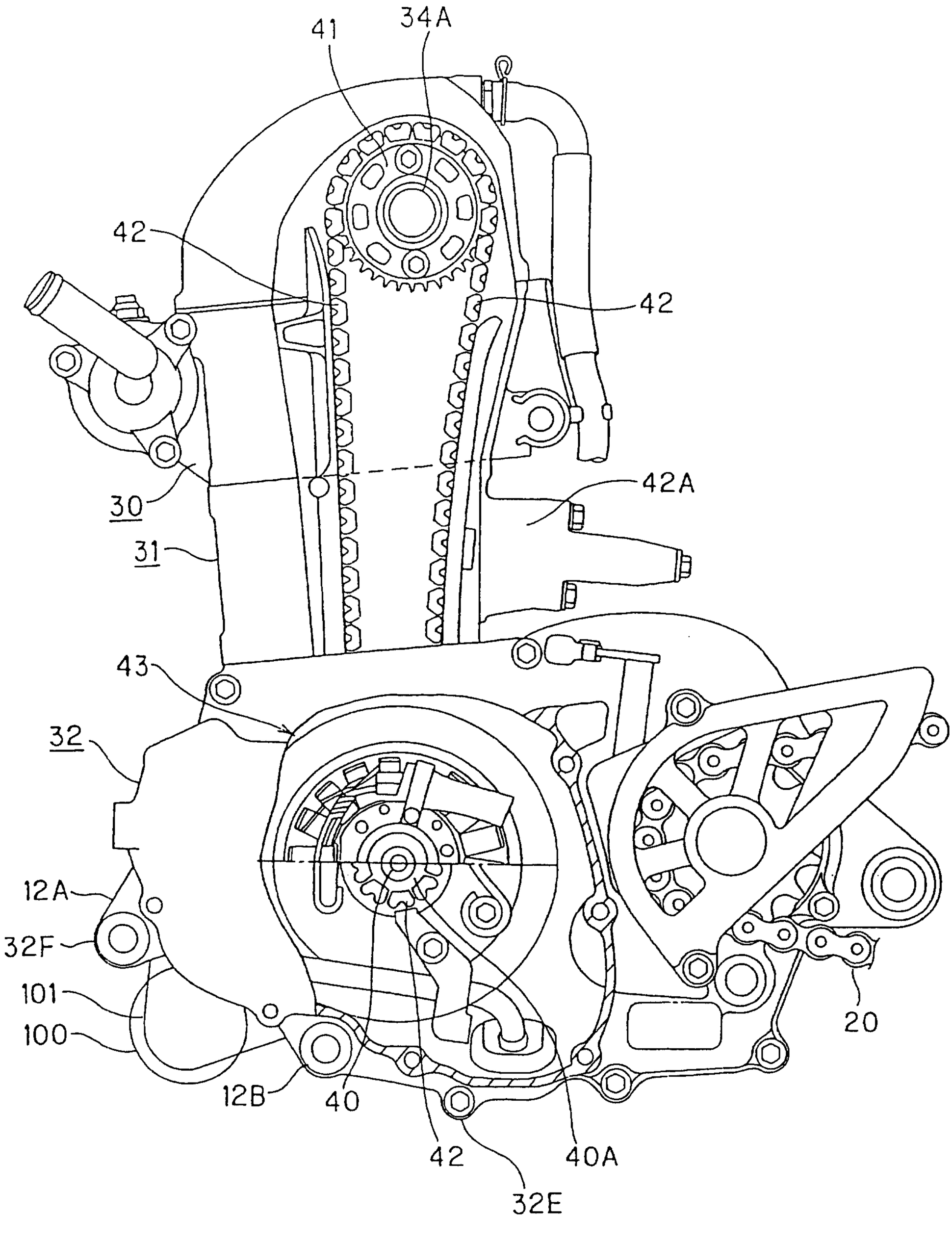
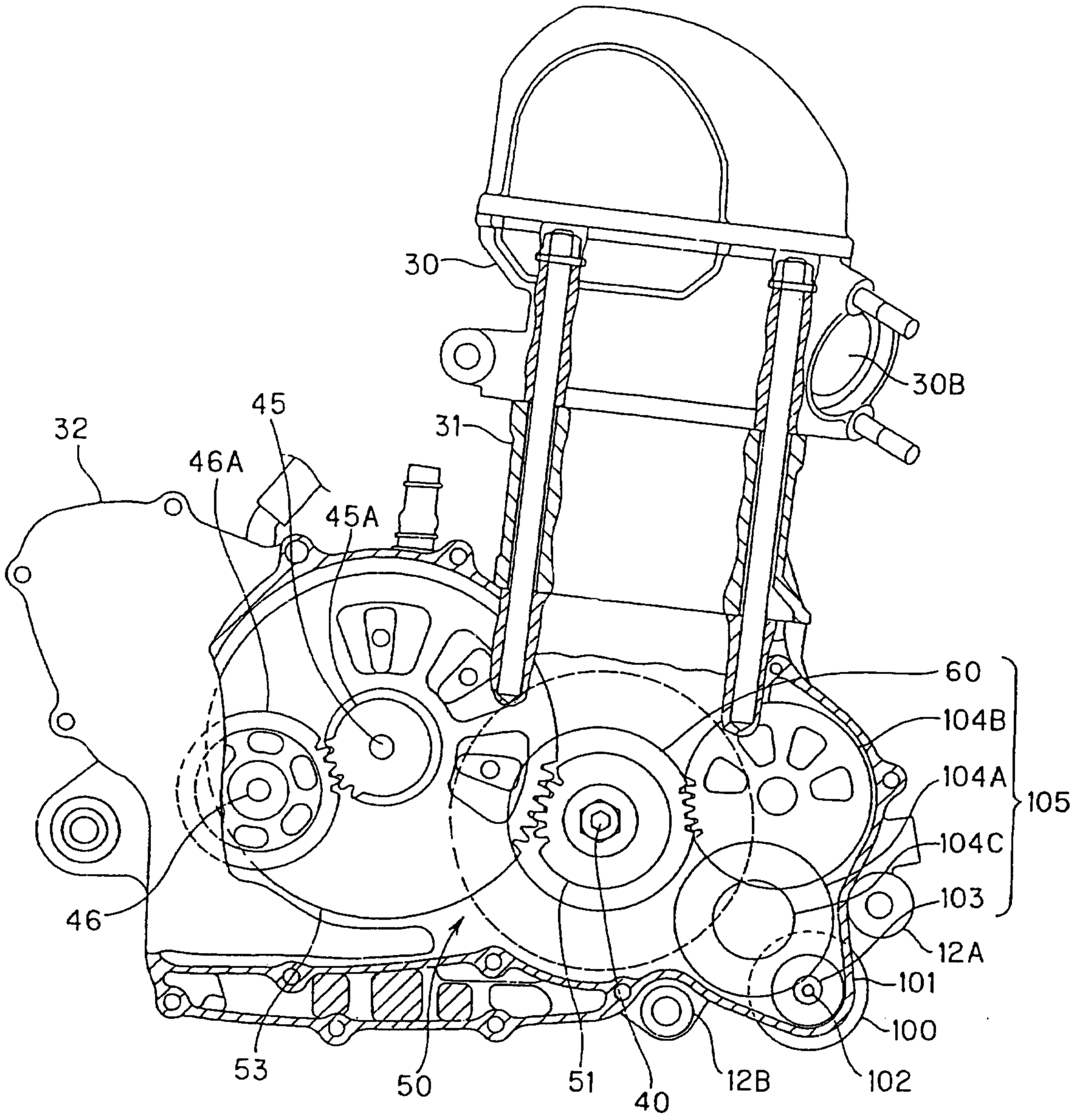
33B
34A
12
32A
32B
30
30A
30B
36
42A
70
45
34
31A
45A
O
46
46A
31
33
35
32
12A
32F
100
101
40
12B
32E
47
48A
48
45

[Fig.6]



[Fig.7]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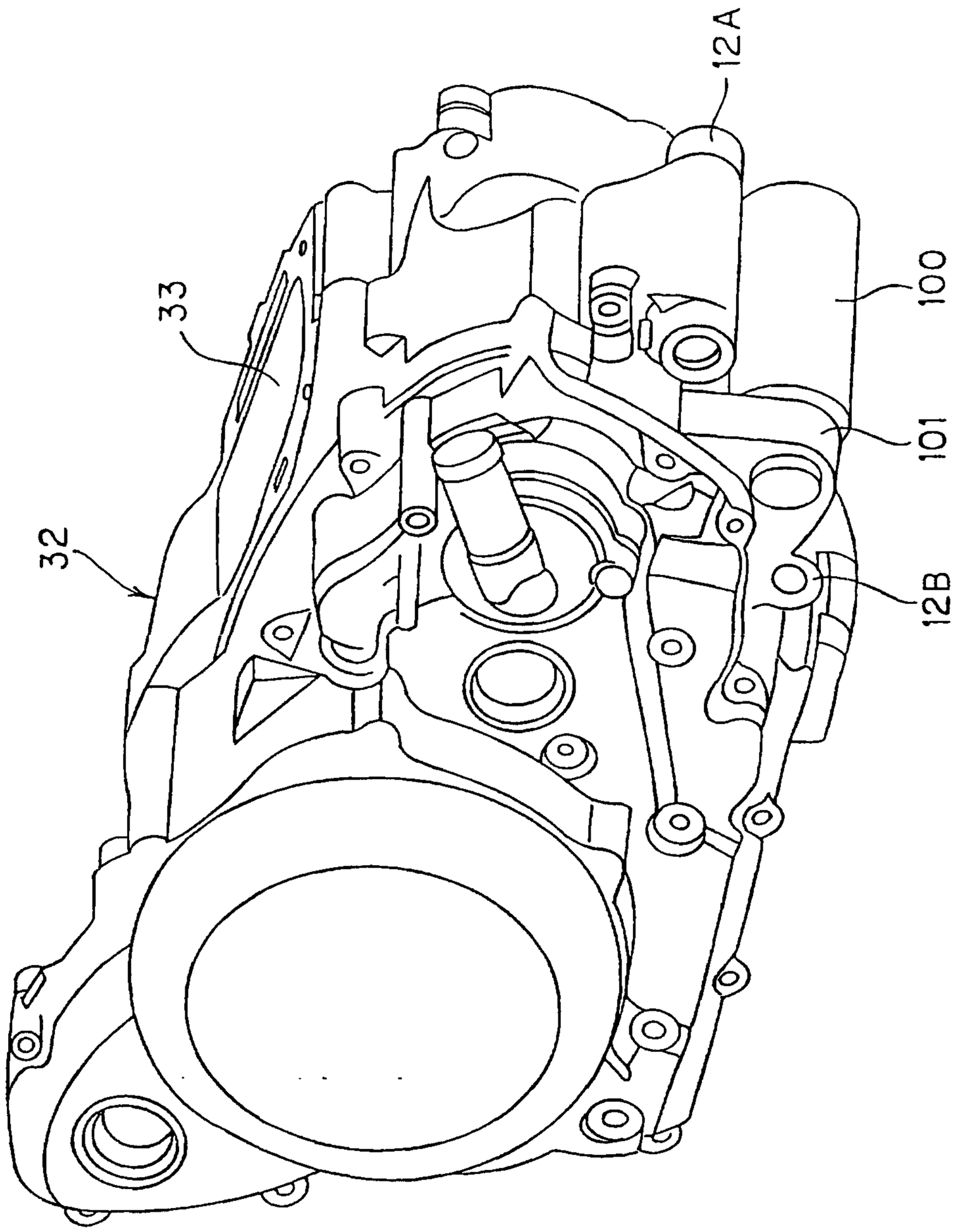
30B
31
32
45
46A
45A
60
104B
104A
105
104C
103
12A
101
100
102
12B
40
51
50
53
46

[Fig.8]



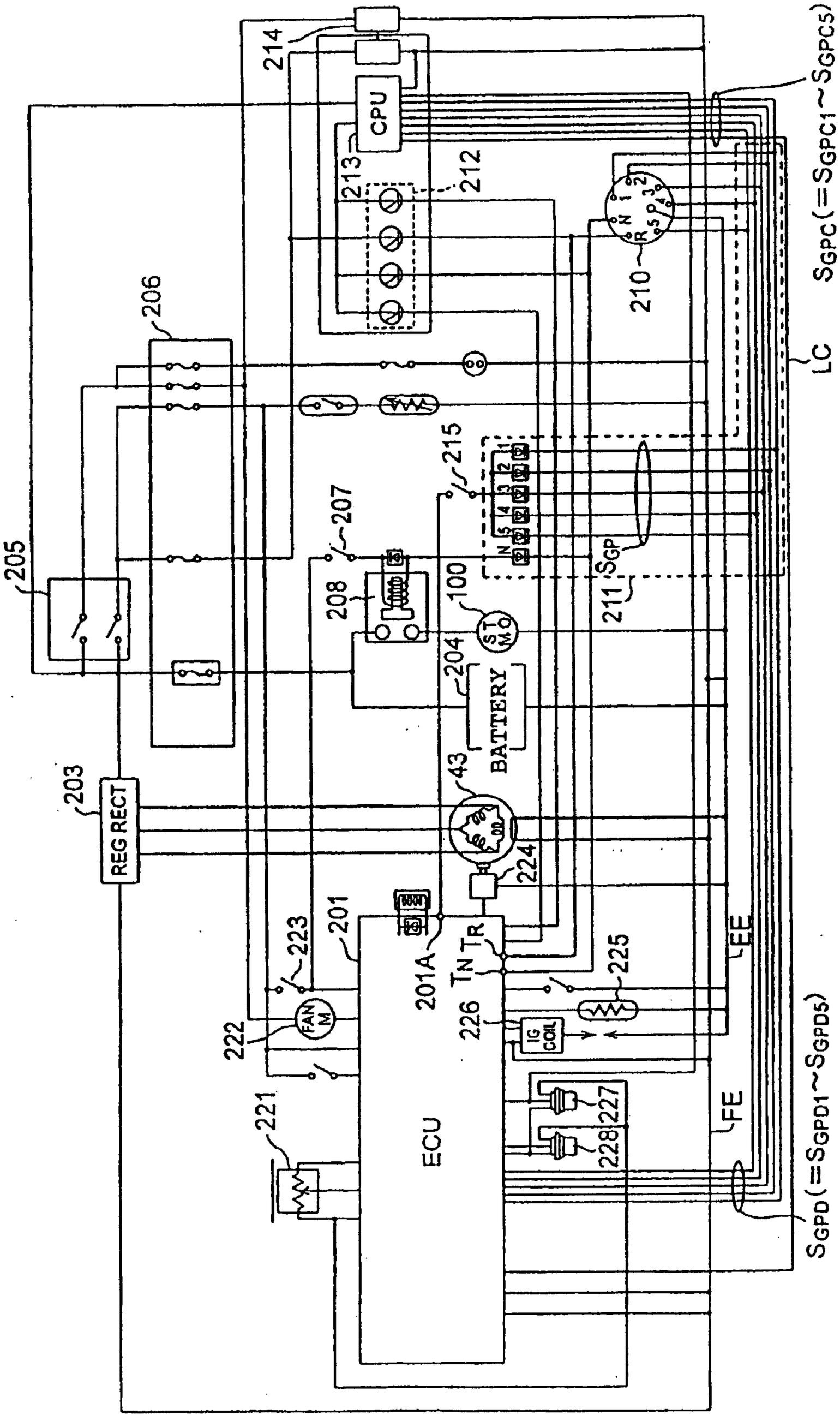

214
CPU
213
212
206
210
215
207
205
208
100
204
211
S_{GP}
BATTERY
203
REG RECT
43
224
201
223
201A
T_N
T_R
225
222
226
IG COIL
221
227
228
ECU
LC
EE
FE
S_{GPC} (=S_{GPC1}~S_{GPC5})
S_{GPD} (=S_{GPD1}~S_{GPD5})

Fig. 9