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(72) Inventors:
 • **Imai, Takuya**
Nirasaki Factory, Mitsui M and S Co., Ltd
Nirasaki-shi, Yamanashi-ken (JP)
 • **Ozaki, Chiho**
Nirasaki Factory, Mitsui M and S Co., Ltd
Nirasaki-shi, Yamanashi-ken (JP)

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(74) Representative: **Jensen, Peter Kim et al**
Chas. Hude A/S
33, H.C. Andersens Boulevard
1780 Copenhagen V (DK)

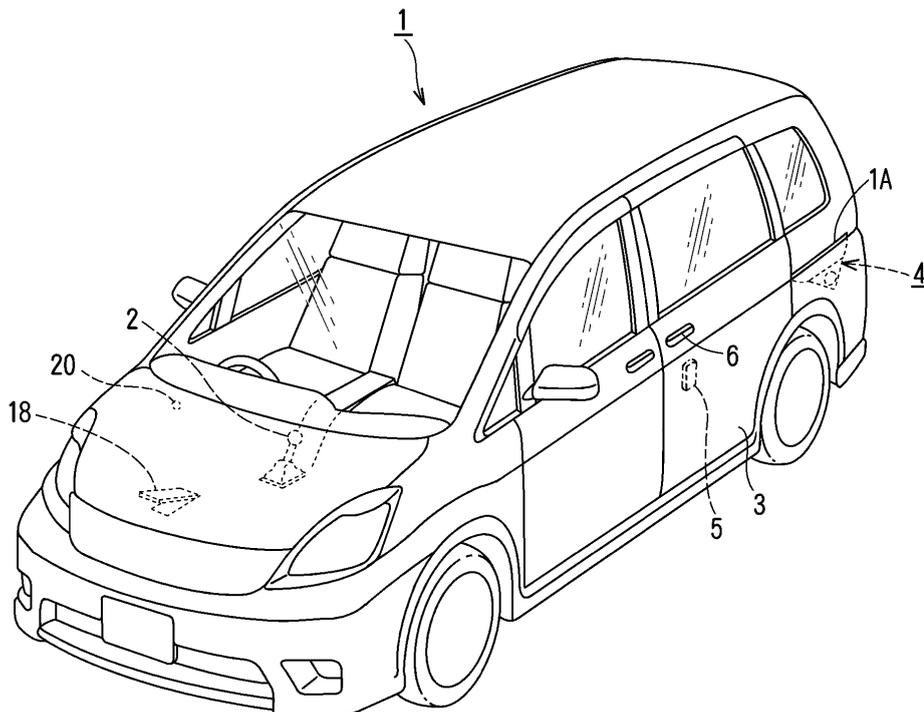
(71) Applicant: **Mitsui Mining & Smelting Co., Ltd**
Tokyo (JP)

(54) **Door-Opening Control Device**

(57) A door-opening control device for a manual transmission car comprises an opening drive unit 4 for opening and closing a vehicle door 3. If an ignition switch 20 is off, or if the ignition switch 20 is on, if a neutral sensor 11 detects a neutral position and if an accelerator-pedal pressing sensor 13 does not detect pressing-down

of an accelerator pedal 18, the door 3 is allowed to open and close automatically by the opening drive unit 4. If the ignition switch 20 is on, if the neutral sensor 11 detects a neutral position and if the accelerator-pedal pressing sensor 13 detects pressing-down of the accelerator pedal 18, the door is not allowed to open or close automatically.

FIG. 1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a door-opening control device comprising an opening drive unit for opening and closing a vehicle door with a motor automatically.

[0002] In a door-opening control device for a vehicle door, a transmission gear ratio of a transmission in an automatic car is shifted automatically by a gear lever. As disclosed in Japanese Patent No.3,467,17082, when a gear lever is in a neutral position, when vehicle speed is below a predetermined vehicle speed, and when a brake pedal or a parking brake lever is operated, a door-moving-permission mode is set to allow the door to open and close automatically with the motor of the opening drive unit device. When the gear lever is not in the neutral or parking position, when the vehicle speed is above a predetermined speed and when the brake pedal or parking brake gear is not operated, a door-moving banning mode is set not to allow the door to open and close with the motor, thereby improving security in opening and closing the door automatically.

[0003] The device in the patent is developed for automatic transmission cars that shift a transmission gear ratio automatically, but is not for manual transmission cars that shift a transmission manually.

[0004] It is an object of the invention to provide a door-opening control device suitable for a manual transmission car shifting a transmission gear ratio manually.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

Fig. 1 is a perspective view of a vehicle having one embodiment of an opening control device according to the present invention.

Fig. 2 is a block diagram showing a control system of the opening control device.

Fig. 3 is a flowchart showing judgment process of a vehicle-stop determining portion.

Fig. 4 is a flowchart showing judgment process of a neutral-sensor "on"-failure determining portion.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0006] A manual transmission vehicle 1 includes a gear lever 2 for shifting a transmission gear ratio of a transmission manually. A sliding door 3 on the side of the vehicle 1 moves with an inner handle 5 and an outer handle 6 by hand or with an opening device 4 mounted to the vehicle 1 from a fully-closed position to a fully-open position along the side of the vehicle 1 rearward and outward a little and vice versa.

[0007] The opening device 4 comprises a reversible motor 41 ; a drum (not shown) reversibly rotating with a

decelerator for the motor 41 ; a cable (not shown) wound on and off the drum and disposed along a guide rail 1 A for supporting the door 3 which slides back and forth and connected to the rear end of the door 3; and a frictional or engagable electromagnetic clutch 42 for disconnecting a power transmitting path between the motor 41 and the drum. By connecting the electromagnetic clutch 42 with each switch (later described), the opening device 4 allows rotation of the motor 41 to be transmitted to the door 3 via the decelerator, drum and cable to allows the door 3 to open and close. When the electromagnetic clutch 42 is disconnected, the door 3 is opened or closed by hand without resistance reversing the decelerator or motor 41. The motor 41 and the electromagnetic clutch 42 are controlled by a control circuit 7 in the vehicle as described later.

[0008] A block diagram in Fig. 2 shows a connection between the control circuit 7 and each electric element, and the control circuit 7.

[0009] The control circuit 7 comprises an operating portion 71 for controlling each of the electric elements; a motor speed detecting circuit 73 for detecting rotation speed of the motor 41 responsive to a pulse signal from a rotation sensor 43 detecting rotation of the motor 41 in the opening device 4; a door-speed detecting circuit 74 for detecting opening speed of the door 3 responsive to a pulse signal from a rotation sensor 44 detecting rotation of the drum; a voltage detector 75 for detecting output voltage from a battery 17 which is a main power source in the vehicle; a clutch control circuit 76 for controlling the electromagnetic clutch 42; a PWM control circuit 77 for controlling the motor 41 with PWM (Pulse Width Modulation); and a current detecting circuit 78 for detecting an electric current supplied from the PWM control circuit 77.

[0010] To an input portion 72 of the operating portion 71, an operating signal is transmitted from an inner handle switch 8 for detecting operation of the inner handle 5; an outer handle switch 9 for detecting operation of the outer handle 6; a wireless switch receiver 10 for receiving signals operating a portable wireless switch; a main switch 14 close to the driver's seat; a driver's seat switch 15 for opening and closing the door 3 at the driver's seat; and a rear seat switch 16 close to the rear seat. A vehicle condition detecting signal is transmitted to the input portion 72 from a neutral sensor 11 for detecting a neutral position of the gear lever 2 to allow the sensor 11 to turn on when the gear lever 2 is in the neutral position; a vehicle speed sensor 12 for detecting vehicle speed; an accelerator-pedal-pressing sensor 13 for detecting pressing-down of the accelerator pedal 18; an engine-speed sensor 19 for detecting speed of an engine or motor as power source of the vehicle 1. A signal is transmitted from a motor-speed detecting circuit 73, a door-speed detecting circuit 74 and a voltage detector 75, and an on-off signal is transmitted from an ignition switch 20. The vehicle condition detecting signal is transmitted from the neutral sensor 11, vehicle-speed sensor 12, accelerator-

pedal-pressing sensor 13 and engine speed sensor 19 to the input portion 72 via CAN (Controller Area Network) communications. At least one of the inner handle switch 8, outer handle switch 9, wireless switch receiver 10, driver's seat switch 15, and rear seat switch 16 is a switch according to the present invention.

[0011] The main switch 14 turns on to allow the opening device 4 to open the door 3 responsive to a signal from one of the inner handle switch 8, outer handle switch 9, wireless switch receiver 10, driver's seat switch 15 and rear seat switch 16. Meanwhile the main switch 14 turns off and does not drive the opening device 4.

[0012] To an output portion 79 of the operating portion 71, the motor 41 and electromagnetic clutch 42 are connected via a PWM control circuit 77 and a current detecting circuit 78 and via a clutch control circuit 76 respectively.

[0013] The operating portion 71 includes a vehicle-stop-determining portion 711 for determining whether or not the vehicle 1 meets the stop condition or whether or not it is in safety condition responsive to the vehicle-condition detecting signals transmitting from the neutral sensor 11, vehicle-speed sensor 12, accelerator pedal sensor 13, engine-speed sensor 19 and ignition switch 20; and a neutral-sensor "on"-failure determining portion 712 for determining whether or not the neutral sensor 11 contains on-failure.

[0014] The vehicle-stop-determining portion 711 shifts to door-moving-permission mode for allowing automatic opening and closing of the door 3 with the opening device 4 if the vehicle 1 does not run safely and shifts to a door-moving-banning mode for prohibiting automatic opening and closing of the door 3 if the vehicle 1 is running or is ready to run.

[0015] In the door-moving-permission mode, when a signal is transmitted from any one of the inner handle switch 8, outer handle switch 9, wireless switch receiver 10, driver's seat switch 15 and rear seat switch 16 to the input portion 72, the clutch control circuit 76 controls the electromagnetic clutch 42 under the order of the operating portion 71 and the PWM control circuit 77 controls the motor 41 to rotate normally or reversely to allow the door 3 to open or close automatically with the power of the motor 41. In the door-moving-banning mode, a signal is blocked to make it impossible for the door 3 to open and close. When the main switch 14 is in "off" position, the opening device 4 is not driven even if the operating portion 71 is in the door-moving-permission mode.

[0016] The neutral-sensor "on"-failure determining portion 712 determines whether or not the neutral sensor 11 is "on" although the gear lever 2 is in a position except neutral, or whether or not the neutral sensor 11 contains "on"-failure under the order as shown in a flowchart in Fig. 4. The "on"-failure is repeatedly determined every predetermined time such as every five seconds.

[0017] First, a timer that measures predetermined time is initialized in S1, which shifts to S2. If the neutral sensor 11 is "on" (YES) or if it is determined that the gear lever

2 is in the neutral position, it shifts to S3. If it is "off" or if the gear lever 2 is in a position except neutral, it shifts to S7. In S7, "on"-failure determination of the neutral sensor is cancelled and the judgment ends.

5 **[0018]** S3 determines whether or not the vehicle runs with the signal from the vehicle-speed sensor 12. If it detects vehicle speed (YES) or if it determines that the vehicle runs although the neutral sensor 11 detects the neutral position of the gear lever 2, it shifts to S4. If S3 detects no vehicle speed (NO) or if the neutral sensor 11 detects a neutral position and determines that the vehicle does not run, it shifts to S8. When the neutral sensor 11 was already determined to involve failure (YES) in S8, it shifts to S9 and determines that the neutral sensor 11 contains "on"-failure, and when no failure was determined (NO), it ends with the judgment of no failure on the basis of the former determination.

10 **[0019]** When the neutral sensor 11 was already determined to have "on"-failure (NO), it shifts to S5. When no failure was already determined, it will shift to S9 without further determination. "On"-failure is determined that the neutral sensor 11 involves "on"-failure and the judgment ends.

15 **[0020]** S5 determines whether or not the accelerator pedal 18 is pressed down responsive to a detect signal from the accelerator pedal pressing sensor 13. If the pedal 18 is pressed down (YES), S5 shifts to S6. If predetermined time passes (YES) in S6, it shifts to S9 in which it is determined that "on"-failure occurs in the neutral sensor 11, and the judgment ends. Meanwhile, if it is determined in S5 that the accelerator pedal 18 is not pressed down (NO), no failure in the neutral sensor 11 is determined on the basis of the former judgment.

20 **[0021]** With respect to a flowchart in Fig. 3, how to determine the condition for stopping a vehicle will be described. First, S11 determines whether the ignition switch 20 (IGN) is on or off. If it is on (YES) or if the engine runs, it shifts to S12. If it is off (NO) or if the engine does not run, it shifts to S16.

25 **[0022]** S16 sets a door-moving-permission mode, ignoring the determination of the neutral-sensor "on"-failure determining portion 712 or detection of the vehicle-speed sensor 12, neutral sensor 11, accelerator-pedal-pressing sensor 13 and engine-speed sensor 19. This is carried out to avoid inconvenience that the door 3 cannot open or close automatically with the opening device 4 although the vehicle 1 is parked in safety condition. Specifically, unlike an automatic transmission car, a manual-transmission car can be parked by allowing the gear lever 2 to put in a first position, not in a neutral position instead of or together with a hand brake. In this condition, it is very inconvenient for the door 3 to open or close automatically. To avoid such inconvenience, in this embodiment, if the ignition switch 20 is off, the opening device 4 is always permitted to drive the door 3 to enable it to open and close automatically.

30 **[0023]** On the basis of the determination results in the neutral-sensor "on"-failure determining portion 712, if the

neutral sensor 11 involves no "on"-failure (NO) in S12, it shifts to S13, or if it involves "on"-failure (YES), it shifts to S17.

[0024] In S17, the neutral-sensor "on"-failure determining portion 712 determines that the neutral sensor 11 involves "on"-failure, so that there is a possibility that the neutral sensor 11 is on although the gear lever 2 is in a position except neutral. Thus, by setting door-moving-banning mode, the door 3 is not allowed to open and close automatically.

[0025] S13 determines whether or not the gear lever 2 is in the neutral position responsive to the signal detected by the neutral sensor 11. If it is determined to be in the neutral position (YES), it shifts to S14, while if in a position except neutral (NO), it shifts to S17 in which the door-moving-banning mode is set so as not to allow the door 3 to open and close automatically.

[0026] S14 determines whether or not the vehicle 1 is running responsive to the signal detected by the vehicle-speed sensor 12. If it is determined not to run (NO), it shifts to S15, while determined to be still running (YES), for example, when the vehicle 1 is still running on a slope with the gear lever 2 in the neutral position, it shifts to S17 in which the door-moving-banning mode is set so as not to allow the door 3 to open and close automatically.

[0027] S15 determines whether or not the accelerator pedal 18 is pressed down responsive to the signals detected by the accelerator pedal pressing sensor 13. If not pressed down (NO), it shifts to S16, while if pressed down (YES), it shifts to S17 responsive to the determination the driver intends to start. By setting door-moving-banning mode, the door 3 is not allowed to open or close automatically.

[0028] S16 sets door-moving-permission mode to allow the door 3 to open and close automatically by determining safety when a passenger get on and off the vehicle since the neutral-position "on"-failure determining portion 712 determines no "on"-failure in the neutral sensor 11 with the gear lever 2 in the neutral position, while the vehicle 1 does not run and the accelerator pedal 18 is not pressed down.

[0029] One embodiment of the invention is described, but the following variations may be made without departing from the scope of claims.

[0030]

- (i) Other than a sliding door, the present invention may apply to a swing-type side door or a tailgate.
- (ii) The present invention may apply to a vehicle changeable by a gear lever between an automatic transmission and a manual transmission.
- (iii) If the vehicle speed is lower than predetermined very low speed, it is judged that the vehicle is deemed not to run.
- (iv) If a pressing extent on the accelerator pedal 18 is lower than predetermined, it is judged that the accelerator pedal 18 is deemed not to be pressed down.

(v) Instead of detecting the accelerator-pedal pressing amount by the accelerator-pedal pressing sensor 13, the judgment is based on whether or not engine speed detected by the engine speed sensor 19 exceeds a predetermined value.

Claims

1. A door-opening control device comprising:

an ignition switch;
 an opening drive unit that opens and closes a vehicle door by a motor with a switch;
 a neutral sensor that detects a neutral position of a gear lever for shifting a transmission gear ratio of an accelerator pedal;
 an accelerator-pedal pressing sensor that detects pressing-down of the accelerator pedal;
 and
 a control circuit connected to the ignition switch, the opening drive unit, the neutral sensor and the accelerator-pedal pressing sensor, **characterized in that:**

the control circuit allows the door to open and close by the opening drive unit if the ignition switch is off, or if the ignition switch is on, if the neutral sensor detects a neutral position and if the accelerator pedal pressing sensor does not detect pressing-down of the accelerator pedal, while the control circuit does not allow the door to open or close by the opening drive unit if the ignition switch is on, if the neutral sensor detects a neutral position and if the accelerator pedal pressing sensor detects pressing-down of the accelerator pedal.

2. The door-opening control device of claim 1 wherein the control circuit comprises a neutral sensor failure determining portion that determines whether to involve failure in the neutral sensor failure determining portion, the door being banned from opening and closing automatically by the opening drive unit if the neutral-sensor-failure determining portion determines a failure, if the ignition switch is on, if the neutral sensor detects a neutral position and if the accelerator-pedal pressing sensor does not detect pressing-down of the accelerator pedal.

3. The door-opening control device of claim 2, further comprising vehicle-speed sensor, the neutral sensor failure determining portion determining that the neutral sensor has failure if the neutral sensor transmits a neutral-position detecting signal, if the vehicle-speed sensor detects running of the vehicle and if the accelerator-pedal sensor detects pressing-down

of the accelerator pedal.

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FIG. 1

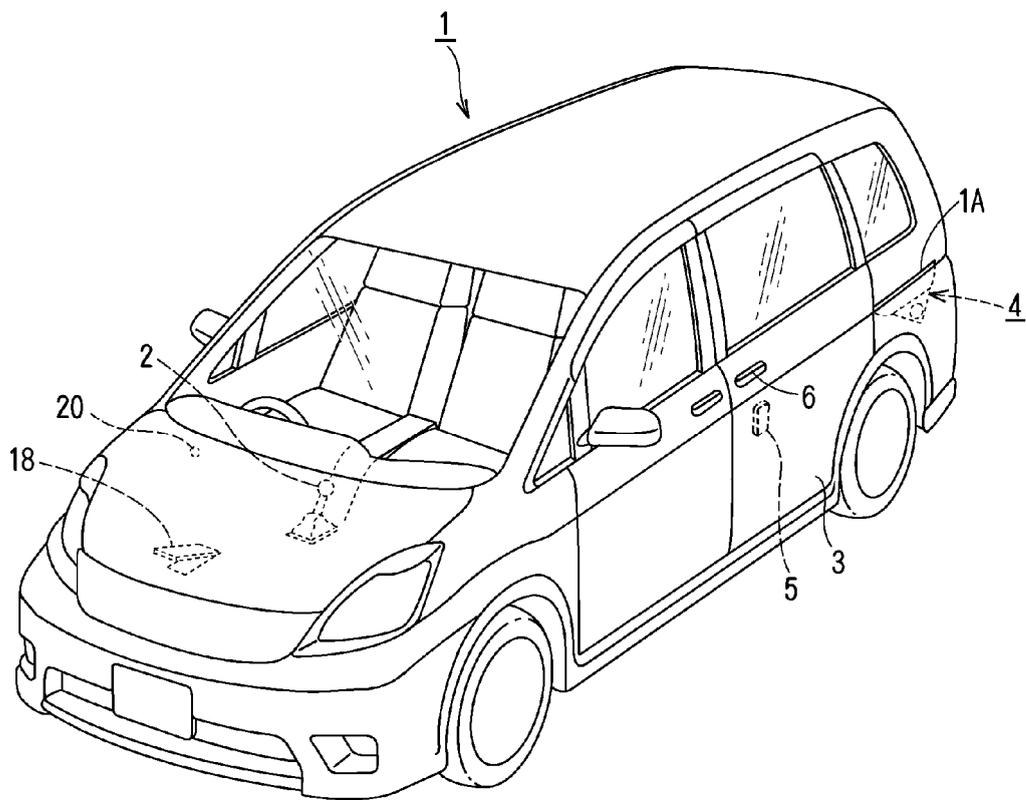


FIG. 2

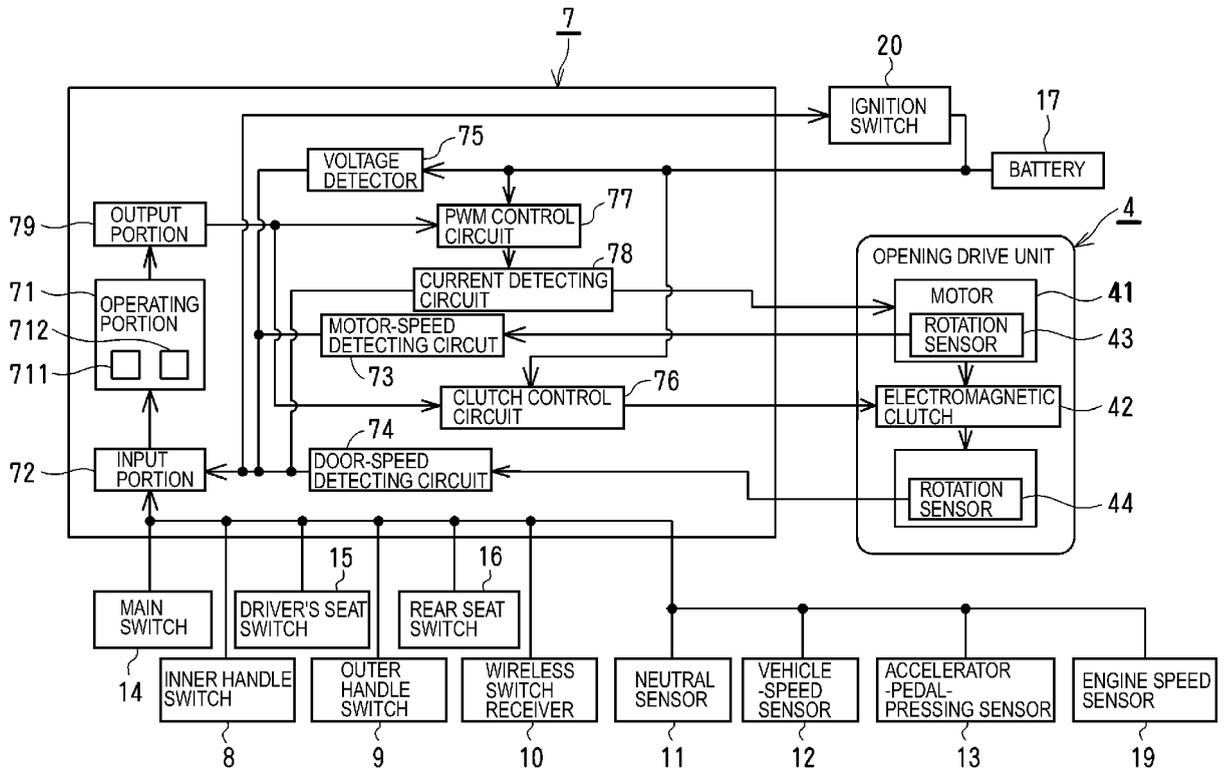


FIG.3

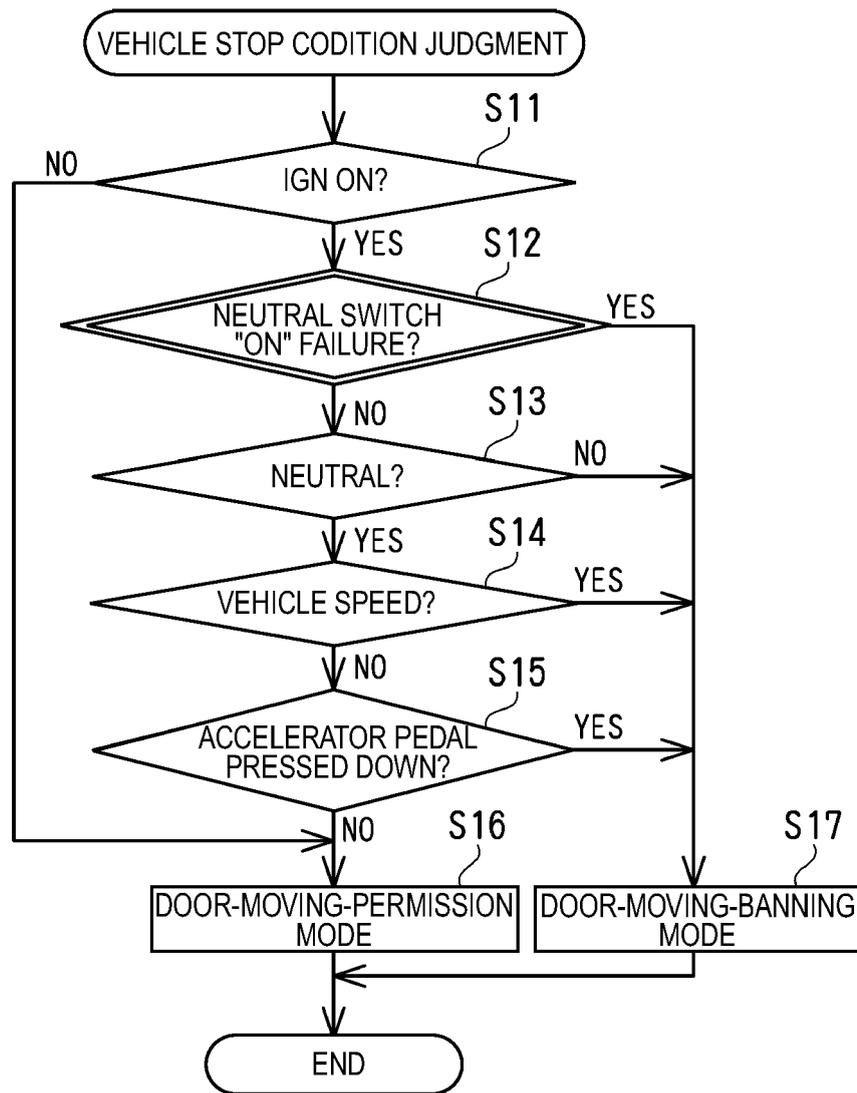
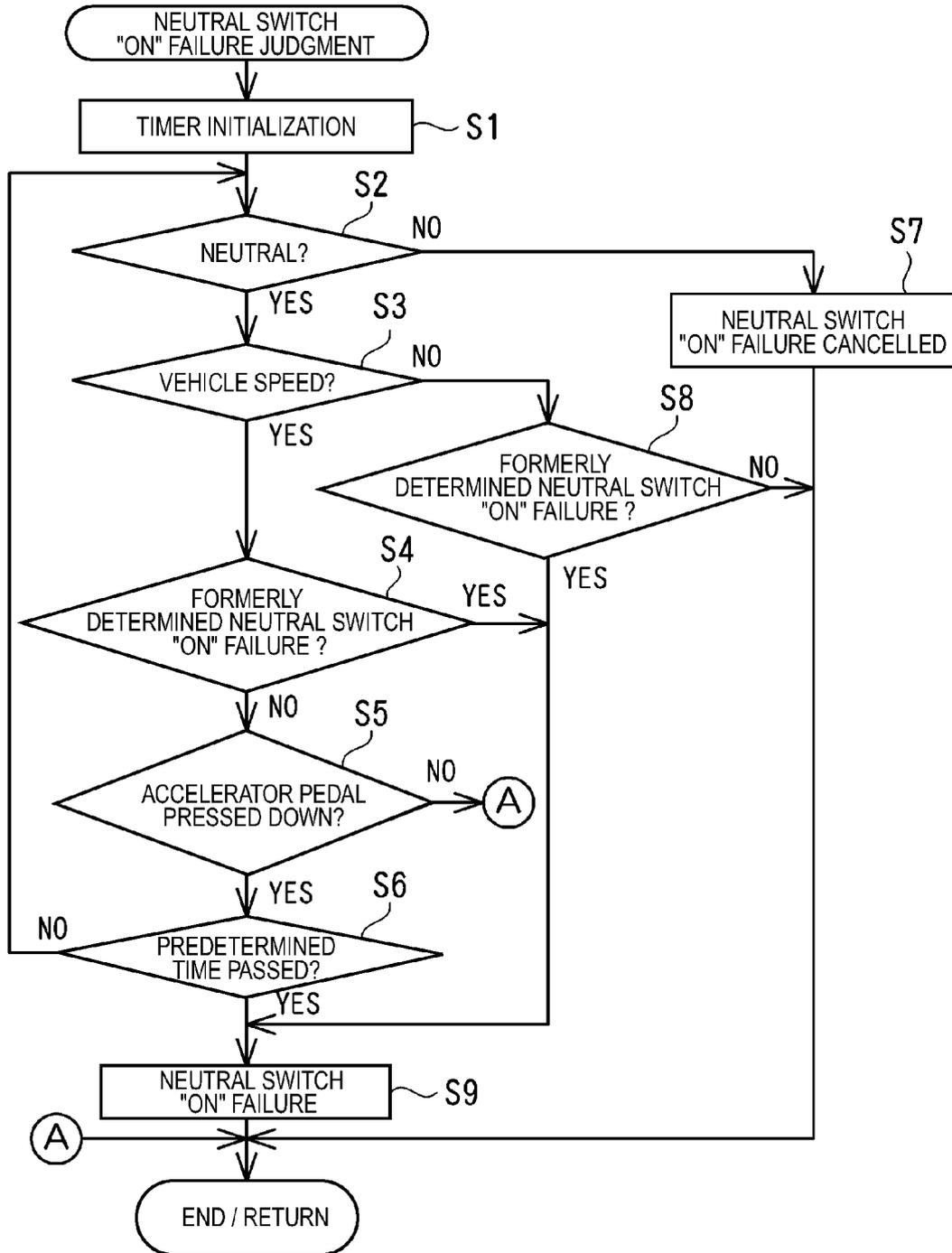


FIG.4



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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