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(54) **SPEED CONTROLLING METHOD FOR VEHICLE**

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SPECIFICATION

1 TITLE OF INVENTION

SPEED CONTROLLING METHOD FOR VEHICLE

2 CLAIMS

A speed controlling method for vehicle which adjusts the position of a speed control element of a vehicle according to the actual measurement value indicating the actual vehicle speed and the set value indicating the target vehicle speed, said method comprising

a process decreasing or increasing said set value by specified quantity according to a respective number of times of accelerating operation and decelerating operation regardless of set operation and cancel operation,

a process indicating said set value,

a process which adjusts the position of the speed control element using said set value and actual value from when set operation is performed to when cancel operation is performed.

3 DETAILED DESCRIPTION OF INVENTION

This invention relates to a speed controlling method for vehicle controlling automatically so that the vehicle speed such as a passenger car follows the target speed, and especially applies to the cruise control system which maintains the vehicle speed at set constant speed.

The cruise control system is useful in freeing the driver from the trouble of frequently performed adjustment operation of the accelerator pedal. A control system, having the function of accelerating set speed or decelerating set speed, which maintains the cruise control at new speed after change by accelerating or decelerating during cruise control in order to take further advantage of this system, is also known.

As a general example, as shown in Examined Patent Publication (Kokoku) No. S51-24677, the configuration is: during when the accelerating switch or the decelerating switch is turned on, while the output signal, which forcibly drives speed control element to the accelerating side or decelerating side by acting on the output circuit, is generated from the output circuit, the actual vehicle speed signal after accelerating or

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decelerating is stored newly as the control reference value with the action on the memory circuit with the timing of resuming the accelerating switch or the decelerating switch.

The drawback of this system becomes having to continue to turn on the accelerating switch or the decelerating switch at the time of accelerating or decelerating until the actual vehicle speed changes to the target value. Because of this, the driver's one arm is being constrained during the vehicle speed change, and this is inconvenient when it is necessary to conduct vehicle speed change and other operation at the same time, for example, changing lanes or in the case of passing, for example.

Moreover, the time to turn on the switch required for the actual vehicle speed to change until the target value changes significantly each time depending on the traveling burden, for example, road surface inclination or vehicle load weight, resulting in a sense of inconvenience during driving.

Disclosed in another example is the control system of Utility Model Application Publication No. S54-596, wherein switching the accelerating switch or the decelerating switch with one touch acts on the memory circuit, thereby forcefully increasing or decreasing only a set amount of the electric quantity indicating the target vehicle speed.

According to this system, the advantage is that the system requires only a short time to turn on the switch.

The present invention is an improvement of this system, and the first purpose of the present invention is to increase and decrease the target speed with one touch during speed control and make it possible to transfer the vehicle speed, while at the same time to enable to increase and decrease the target speed of speed control to be started with one touch even before speed control. The second purpose of the present invention is to make it possible to easily conduct the increase and decrease operation by displaying the value of the target speed.

According to the preferred embodiment of the present invention, the set value indicating the target vehicle speed is processed as a digital value in the digital control circuit, especially microcomputer. And by the increase and decrease operation conducted by the driver and the increase and decrease operation, the digital set value indicating the target vehicle speed is increased and decreased by the specified quantity only for the set number of times of the operation. This process is performed regardless of whether it is during the speed control or not, and the increased and decreased set value is displayed by the display device. The speed control is started by the set operation (start operation) which is going to execute the speed control with the set value as the target speed.

To process the set value as the digital value, in the case of continuing speed control for a long period of time, has the advantage that the value does not change because of current leakage. Moreover, the digital value is advantageous in the case of using a numeric speed display device.

In Figure 1 showing the first embodiment of the present invention, (1) is the electrical signal processing circuit (controller), and this controller is provided with microcomputer (1A) in which the processing step such as input, output, computing, and memory is preset by a computer program, and furthermore, necessary input signal is transmitted from the sensor and switch to this microcomputer; in addition, an appropriate transmission circuit which transmits output signals to the actuator from the microcomputer is provided.

The microcomputer, as is well known, is provided with a temporary memory (RAM) other than the program memory (ROM), and according to the present invention, part of this temporary memory is used to store the digital set value indicating the target speed.

(2) is an actuator which displaces the position of the throttle valve 7, which is a speed control element of a vehicle, by the signal of controller (1), and an electric-pneumatic converter which modulates the pressure in the pressure chamber by the switching of magnetic valve according the electrical signal is used. This actuator is provided with an electromagnetic-actuated release valve which communicates with the pressure chamber and the atmosphere to promptly stop the actuation.

(3) is the speed vehicle speed sensor which generates the pulse signals synchronizing with the rotation angle of axle of the vehicle and (4) is the cancel switch which is linked to the clutch pedal and the brake pedal; here, at least the time of operation of one of each pedal is "on" and the time of non-operation of both is referred to as "off." (5) is a self-reset start switch provided to conduct set operation in terms of starting the speed control and is installed in the cover protector of steering rotating shaft. Similarly with this start switch, a self-reset cancel switch can be provided in the vicinity of the start switch to stop the speed control manually and can be used in combination with the pedal switch.

(6) is a control panel and is installed in the vicinity of the steering such as the instrument panel. This control panel comprises decelerating (down) switch (6A), accelerating (up) switch (6B), and display device (6C) to display the set value as numbers indicating the target speed. Depending on the necessity, said start switch (5) or manual cancel switch (4) can be installed in this control panel.

The controller (1) checks the status of cancel switch (4) and start switch (5) by the execution of the program in the microcomputer and determines whether it is under control. If under control, the actual vehicle speed Vs is computed as the digital value based on the pulse signal provided from the vehicle speed sensor (3). As this actual vehicle speed Vs approximates the set value VM of the target vehicle speed stored in RAM, the microcomputer generates the output signal to compute and adjust the displacement magnitude of actuator 2.

Here, the size of the set value VM is increased or decreased by the specified quantity, regardless of whether under control or not, by the number of times of the operation of down-switch (6A) and up-switch (6B) provided on the control panel and is stored again in RAM. The set value VM stored in RAM is output to control panel (6) and is displayed there as a decimal number.

The above operation is implemented by the control program exemplified in Figure 3. Now, if the key switch of the vehicle is turned on, the power source is supplied to the electric system of Figure 1, the microcomputer (1A) is power-on reset in controller (1), and the process starts from the start step 11 of the program.

First, in the initial set step 11, set the status of internal memory, register, and input/output port at the preset status. Here, as the set value VM indicating the target vehicle speed, binary number corresponding to 80 km/H is stored in the specified address of RAM. Furthermore, the value of the set value VM is serial transferred to the control panel. The control panel, when receiving this, parallel converts in the built-in shift register, and furthermore, converts to the light-emitting display signal of 7 segments in the decoder for display in the display device 6C.

Subsequently, the program shifts to the circulation routine of after step 13. In step 13, by the frequency of the pulse signal provided from vehicle speed sensor (3), the calculation is as the value Vs indicating the actual vehicle speed, which will be stored in RAM. Though not shown in figures, the microcomputer sets the interrupt program, activates the interrupt program by synchronizing with the pulse signal from the vehicle sensor, stores sequentially the value of clock counter, and by the difference between the pervious memory value and the latest memory value, the pulse frequency is calculated.

In decision steps 14 and 15, the switch signals of up and down switches (6A) and (6B) switch signals from the control pane (6) is checked, and that from "off" to become "on" is detected. When up-switch (14) is turned on, the set value VM is added only for a set amount C in step 16. This additional value C, for example, is prescribed at the value corresponding to 2 kg/H. On the other hand, in case the down-switch 15 is turned on, the set value VM is subtracted for only the set amount C in step 17.

In this way, the target set value VM, though the initial value 80 km/H is set at first, is increased and reduced by the set amount by the switch operation of the control panel 5 and the value after change is newly stored in RAM. With regards to decision steps 14 and 15, the on timing of the switch is detected, and also, the circulation routine is repeated at higher speed than the time interval of ordinary switch operation of human being so that the set value VM is increased or decreased by only the number of times of the switch operation of human being.

When the set value VM is changed in steps 16 and 17, immediately a new set value VM is transferred in output step 18, and the display of display device (6C) is renewed. Therefore, in control panel (6), the switch operation can be conducted while viewing the target vehicle speed displayed by the display device (6C) and the latest value can be confirmed.

This display continues while the key switch is turned on regardless of whether under speed control or not.

The start and stop of the speed control is decision step 19 and 20, and cancel switch 4 is performed by checking the turned on status of start switch 5. The decisions can be made by detecting whether each switch is in the status of "on" or not.

In the program process, flag F is used in order to determine whether under speed control or not, and when it is detected that the cancel switch 4 is turned on, the value of flag F is 0 in step 21; on the other hand, when it is detected that start switch 5 is turned on, the value of flag F is 1 in step 22. The value of this flag F is set using a specified address of RAM and can be read; in the initial set step 12 mentioned previously, it is preset at 0.

Speed control step 24 is conducted after being determined that the value of flag F is constantly 1. In the case flag F is 0, speed control stop step 25 is executed.

In speed control step 24, the displacement magnitude of actuator (2) relating to the actual vehicle speed and the target vehicle speed is calculated and the calculation result is output. Moreover, in order to have actuator (2) in an operating condition, the output which closes the relief valve is provided to the actuator. The control system used here performs advance compensation using the speed change and conducts the calculation process of the following equation.

$$D = G1 \{VM - Vs - G2 (Vs - Vso)\}$$

More specifically, the adjustment magnitude D of actuator predicts the vehicle speed after thousands of several hundred ms from the actual vehicle speed value Vs and its varying gradients (Vs is the latest value and Vso is the value calculated in advance) and determination is made according to the difference between this predictive value and the target value VM. Here, G1 is gain constant and G2 is advance compensation constant, which are determined in advance and set in the program.

By the repeated execution of speed control step 24, actuator (2) displaces the vehicle speed every minute to approximate to the target speed and adjust the opening of throttle valve (7).

On the other hand, in speed control stop step 25, the output to have the displacement of actuator (2) as 0 is generated. Furthermore, the output to release the release valve of the actuator is provided to the actuator. By the execution of this stop step, the actuator (2) is released from energization and loses the force acting on throttle valve (7). As a result, throttle valve (7) is replaced promptly by the return spring, not shown in the Figure, in the direction of deceleration, more specifically, the direction closing the intake passage, and the speed control operation is left to the driver.

To sum up the operation of this device, first, the initial value "80km/H" is displayed on the display device 6C by turning on the key switch. By turning on up and down switches (6B) and (6A), the set stored value VM is added or subtracted by the set amount and the latest value is constantly maintained as the speed request by the driver. Every time the set value changes, the display of the display device (6C) is changed and the latest target speed is displayed. If start switch 5 is turned on, actuator (2) is displaced by using the set value (the latest value) VM which has remained in RAM and the actual vehicle speed is controlled. In this case, the speed control transfers toward a new target speed. When the cancel switch 4 is turned on, actuator (2) is de-energized and the speed control is stopped.

The device above can be modified and used in combination with the conventional one-touch stored set operation. For example, as shown in the coding (8) in Figure 1, the set switch can be added as the input elements of controller (1), and the program shown in Figure 3 responding to this switch operation is added to the point X. this set switch is arranged in the vicinity of the steering.

And then, step 26 of Figure 3 detects the closing operation of set switch 8, and if there is a closing operation, stores the actual speed value Vs at this time as a set value VM. At this time, it immediately jumps to step 18 and transfers the set value VM to display device (6C).

In the embodiments described above, the display indicating to the driver whether it is during the influence of speed control or not can be performed. The value of said flag F can be used to indicate whether it is during the influence of speed control or not, and depending on the value, the flashing of the display lamp (for example, set up on the control panel (6) can be changed.

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