mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel. The travel control device includes a limit information acquisition unit, a current position acquisition unit, a current speed acquisition unit, a travel curve generation unit, and a speed command unit. The limit information acquisition unit is configured to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit that is configured to set the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position. The current position acquisition unit is configured to acquire a current position of the vehicle. The current speed acquisition unit is configured to acquire a current speed of the vehicle. The travel curve generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position.

[0006]

According to a second aspect of the present invention, the limit information acquisition unit included in the travel control device acquires the limit information which includes a plurality of relative positions up to the front position with the current position

as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions as a sequence. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0007]

According to a third aspect of the present invention, the limit information acquisition unit included in the travel control device acquires limit information including only the sequence with respect to the representative speed among the sequence of the relative positions from the current position to the front position. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0008]

According to a fourth aspect of the present invention, the limit information acquisition unit included in the travel control device acquires the limit information including the relative position from the current position to a deceleration completion position, the speed, and a guaranteed deceleration. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0009]

According to a fifth aspect of the present invention, a vehicle includes a vehicle speed limit unit and a travel control device. The vehicle speed limit unit is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position. The travel control device includes a limit information acquisition unit, a current position acquisition unit, a current speed acquisition unit, travel curve generation unit, and a speed command unit. The limit

information acquisition unit is configured to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit. The current position acquisition unit is configured to acquire a current position of the vehicle. The current speed acquisition unit is configured to acquire the current speed of the vehicle. The travel curve generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position.

[0010]

According to a sixth aspect of the present invention, a traffic system includes the vehicle and a ground ATP device. The vehicle includes a vehicle speed limit unit, a limit information acquisition unit, and a travel control device. The travel control device includes a current position acquisition unit, a current speed acquisition unit, a travel curve generation unit, and a speed command unit. The vehicle speed limit unit is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position. The limit information acquisition unit is configured to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit. The current

speed acquisition unit is configured to acquire a current speed of the vehicle. The travel curve generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position. The ground ATP device outputs the speed limit start position to the vehicle speed limit unit.

[0011]

According to a seventh aspect of the present invention, a control method of a travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel. The method includes: causing a limit information acquisition unit of the travel control device to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position; causing a current position acquisition unit of the travel control device to acquire a current position of the vehicle; causing a current speed acquisition unit of the travel control device to acquire a current speed of the vehicle; causing a travel curve generation unit of the travel control device to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and causing a speed command unit of the travel control device to

generate a speed command according to the generated travel curve and the current position.

[0012]

According to an eighth aspect of the present invention, a program causes a computer in a travel control device which is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel to function as: limit information acquiring means for acquiring limit information including speed limit information and the position information corresponding to the speed limit, from a vehicle speed limit unit that is configured to set the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position; current position acquiring means for acquiring a current position of the vehicle; current speed acquiring means for acquiring a current speed of the vehicle; travel curve generating means for generating a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and speed commanding means for generating a speed command according to the generated travel curve and the current position.

[0013]

According to the travel control device, the vehicle, the traffic system, the control method, and the program described above, it is possible to reduce the travelling time of the train with respect to the travelling distance when the automatic driving is performed on the vehicle using the travel control device.

CLAIMS

1.(Amended) A travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, the device comprising:

a limit information acquisition unit that is configured to acquire limit information which is acquired from a ground automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit that is configured to set the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current speed acquisition unit that is configured to acquire a current speed of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

2.(Amended) The travel control device according to Claim 1,

wherein the limit information acquisition unit is configured to acquire the limit

information which includes a plurality of relative positions up to the front position with the current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions as a sequence, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

3.(Amended) The travel control device according to Claim 1 or Claim 2,

wherein the limit information acquisition unit is configured to acquire limit information including only the sequence with respect to the representative speed among the sequence of the relative positions from the current position to the front position, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

4. The travel control device according to Claim 1 or Claim 2,

wherein the limit information acquisition unit is configured to acquire the limit information including the relative position from the current position to a deceleration completion position, the speed, and a guaranteed deceleration, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

5.(Amended) A vehicle comprising:

a vehicle speed limit unit that is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a limit information acquisition unit that is configured to acquire limit

information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current speed acquisition unit that is configured to acquire a current speed of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

6.(Amended) A traffic system comprising:

a vehicle that includes:

a vehicle limit unit that is configured to set speed limits at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a limit information acquisition unit that is configured to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit

information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

7.(Amended) A control method of a travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, the method comprising:

causing a limit information acquisition unit of the travel control device to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

causing a current position acquisition unit of the travel control device to acquire

a current position of the vehicle;

causing a current speed acquisition unit of the travel control device to acquire a current speed of the vehicle;

causing a travel curve generation unit of the travel control device to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

causing a speed command unit of the travel control device to generate a speed command according to the generated travel curve and the current position.

8.(Amended) A program causing a computer in a travel control device, which is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, to execute the method comprising the steps of:

causing a limit information acquisition unit of the travel control device to acquire limit information which is acquired from an automatic train protection (ATP) device installed on the ground by a vehicle speed limit unit and indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

causing a current position acquisition unit of the travel control device to acquire a current position of the vehicle;

causing a current speed acquisition unit of the travel control device to acquire a current speed of the vehicle;

causing a travel curve generation unit of the travel control device to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

causing a speed command unit of the travel control device to generate a speed command according to the generated travel curve and the current position.

mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel. The travel control device includes a limit information acquisition unit, a current position acquisition unit, a current speed acquisition unit, a travel curve generation unit, and a speed command unit. The limit information acquisition unit is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit that is configured to set the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position. The current position acquisition unit is configured to acquire a current position of the vehicle. The current speed acquisition unit is configured to acquire a current speed of the vehicle. The travel curve generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position.

[0006]

According to a second aspect of the present invention, the limit information acquisition unit included in the travel control device acquires the limit information which includes a plurality of relative positions up to the front position with the current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions as a sequence. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0007]

According to a third aspect of the present invention, the limit information acquisition unit included in the travel control device acquires limit information including only the sequence with respect to the representative speed among the sequence of the relative positions from the current position to the front position. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0008]

According to a fourth aspect of the present invention, the limit information acquisition unit included in the travel control device acquires the limit information including the relative

position from the current position to a deceleration completion position, the speed, and a guaranteed deceleration. The travel curve generation unit included in the travel control device generates the travel curve according to the limit information.

[0009]

According to a fifth aspect of the present invention, a vehicle includes a vehicle speed limit unit and a travel control device. The vehicle speed limit unit is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position. The travel control device includes a limit information acquisition unit, a current position acquisition unit, a current speed acquisition unit, travel curve generation unit, and a speed command unit. The limit information acquisition unit is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit. The current position acquisition unit is configured to acquire a current position of the vehicle. The current speed acquisition unit is configured to acquire the current speed of the vehicle. The travel curve generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position.

[0010]

According to a sixth aspect of the present invention, a traffic system includes the vehicle and a ground ATP device. The vehicle includes a vehicle speed limit unit, a limit information acquisition unit, and a travel control device. The travel control device includes a current position acquisition unit, a current speed acquisition unit, a travel curve generation unit, and a speed command unit. The vehicle speed limit unit is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position. The limit information acquisition unit is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit. The current speed acquisition unit is configured to acquire a current speed of the vehicle. The travel curve

generation unit is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed. The speed command unit is configured to generate a speed command according to the generated travel curve and the current position. The ground ATP device outputs the speed limit start position to the vehicle speed limit unit.

[0011]

According to a seventh aspect of the present invention, a control method of a travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel. The method includes: causing a limit information acquisition unit of the travel control device to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position; causing a current position acquisition unit of the travel control device to acquire a current position of the vehicle; causing a current speed acquisition unit of the travel control device to acquire a current speed of the vehicle; causing a travel curve generation unit of the travel control device to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and causing a speed command unit of the travel control device to generate a speed command according to the generated travel curve and the current position.

[0012]

According to an eighth aspect of the present invention, a program causes a computer in a travel control device, which is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, to function as: limit information acquisition means for acquiring limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed

limit start position; current position acquisition means for acquiring a current position of the vehicle; current speed acquisition means for acquiring a current speed of the vehicle; travel curve generation means for generating a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and speed command means for generating a speed command according to the generated travel curve and the current position.

Advantageous Effects of the Invention

[0013]

According to the travel control device, the vehicle, the traffic system, the control method, and the program described above, it is possible to reduce the travelling time of the train with respect to the travelling distance when the automatic driving is performed on the vehicle using the travel control device.

Claims

1. A travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, the device comprising:

a limit information acquisition unit that is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit that is configured to set the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current speed acquisition unit that is configured to acquire a current speed of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

2. The travel control device according to Claim 1,

wherein the limit information acquisition unit is configured to acquire the limit information which includes a plurality of relative positions up to the front position with the current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions as a sequence, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

3. The travel control device according to Claim 1 or Claim 2,

wherein the limit information acquisition unit is configured to acquire limit information including only the sequence with respect to the representative speed among the sequence of the relative positions from the current position to the front position, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

4. The travel control device according to Claim 1 or Claim 2,

wherein the limit information acquisition unit is configured to acquire the limit information including the relative position from the current position to a deceleration completion position, the speed, and a guaranteed deceleration, and

wherein the travel curve generation unit is configured to generate the travel curve according to the limit information.

5. A vehicle comprising:

a vehicle speed limit unit that is configured to set a speed limit at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a limit information acquisition unit that is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current speed acquisition unit that is configured to acquire a current speed of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

6. A traffic system comprising:

a vehicle that includes:

a vehicle limit unit that is configured to set speed limits at each position in order to achieve a predetermined deceleration completion speed at the speed limit start position;

a limit information acquisition unit that is configured to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a current position acquisition unit that is configured to acquire a current position of the vehicle;

a travel curve generation unit that is configured to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a

predetermined speed, according to the acquired limit information, the current position, and the current speed; and

a speed command unit that is configured to generate a speed command according to the generated travel curve and the current position.

7. A control method of a travel control device that is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, the method comprising:

causing a limit information acquisition unit of the travel control device to acquire limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

causing a current position acquisition unit of the travel control device to acquire a current position of the vehicle;

causing a current speed acquisition unit of the travel control device to acquire a current speed of the vehicle;

causing a travel curve generation unit of the travel control device to generate a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

causing a speed command unit of the travel control device to generate a speed command according to the generated travel curve and the current position.

8. A program causing a computer in a travel control device, which is mounted on a vehicle and sets a travel speed according to a position of the vehicle and causes the vehicle to travel, to function as:

limit information acquisition means for acquiring limit information which indicates a plurality of relative positions to the front position with a current position as a reference and each speed limit information at the front position indicated by each of the plurality of relative positions, from the vehicle speed limit unit of the travel control device that sets the speed limits at a plurality of positions in order to achieve a predetermined deceleration completion speed at the speed limit start position;

current position acquisition means for acquiring a current position of the vehicle;

current speed acquisition means for acquiring a current speed of the vehicle;

travel curve generation means for generating a travel curve in which the speed limit at each position obtained from the limit information becomes lower than a predetermined speed, according to the acquired limit information, the current position, and the current speed; and

speed command means for generating a speed command according to the generated travel curve and the current position.