ATP ground device 232, a station control device 234 and an interlocking device 236. The respective devices are mutually connected by an exclusive-use LAN (Local Area Network) 238 to be bi-directionally communicable. The operation control device 230 controls the whole operation. The interlocking device 236 carries out the protection of traveling routes of the trains. The ATP ground device 232 prevents a collision between the trains. The station control device 234 attains the function safety of the control of the opening/closing of platform screen doors and train doors at a station.

[0004]

Each of the (group of) trains is provided with an on-board device 210. The on-board device 210 controls the operation of the train based on the control of the control center. The on-board device 210 is connected with the ATP ground device 232 by the exclusive-use LAN 250 to be bi-directionally communicable. The station is provided with a remote I/O 220. The remote I/O 220 carries out the opening/closing control of the platform screen door 240 and the control of railroad switches 250 on the railroad track based on the control of the control center. The remote I/O 220 is connected with the station control device 234 and the interlocking device 236 by an exclusive-use LAN 252 to be bi-directionally communicable.

[0005]

The operation of this conventional signaling system (the operation of a train) becomes as described below, for example.

When a departure time of an optional train comes gets closer based on the train diagram, the operation control device 230 refers to the on-rail state 205 from the ATP ground device 232 to check the

with a CPU (Central Processing Unit), a storage section, an input section, an output section and an interface, which are not shown. The center control device 31 executes information processing for the operation control device 30. The center storage unit 32 is a storage unit which is exemplified by a hard disk drive, RAM (Random Access Memory) and ROM (Read Only Memory), and stores data and a software program which are used in the center control device 31, and data and a software program which are outputted from the center control device 31. The center communication device 33 is a radio LAN transmitting and receiving unit which carries out a data communication through the general-purpose LAN 60. The center communication device 33 transmits data and the software program which are outputted from the center control device 31, to the on-board device 10 and the station I/F device 20, and receives data and the software program which are transmitted from the on-board device 10 and the station I/F device 20 to output to the center control device 31.

[0036]

The general-purpose LAN 60 is provided with a plurality of base stations 61. The plurality of base stations 61 are arranged in the control center 4 and each station 3 and at a plurality of locations along the railroad track 500. The base station 61 mediates a radio communication among the operation control device 30, the plurality of the on-board devices 10 and the plurality of the station I/F devices 20 to allow data to be sent and received among them. Note that in the present embodiment, an example using the radio LAN as the communication means is shown. However, different communication means may be used if it is possible to send and receive data among them.

[0037]

showing the train diagram of the train 2. The train diagram data 131 is supplied from the operation control device 30 and is different for every train 2. However, the train diagram data 131 may contain only the train diagram of the train 2 and the neighbor train 2. Or, the train diagram data may be data of an operation interval.

[0054]

When the train 2 is in a stop state, the station related data 132 contains data related to a current station (hereinafter, to be referred to as the station 3A) at which the train 2 is in the stop state, data related to the next station as the station 3 (hereinafter, to be referred to as the station 3B) for the train to be stopped next, data related to a previous station as the station 3 (hereinafter, to be referred to as the station 3C) for the train to have been stopped last time. When the train 2 is traveling, the station related data 132 contains data related to the previous station as the station 3 for the train 2 to have departed and data related to the next station as the station 3. The station related data 132 is updated appropriately (e.g. regularly) and is different for every train 2. The station related data 132 contains the railroad switch switching position data and the inter-station section related data. The railroad switch switching position data shows a switching position of each of the plurality of railroad switches 51 which belongs to the targeted stations 3A, 3B and 3C (the previous station, the current station, the next station), and contains the railroad switch command data (to be described later) of each railroad switch 51. Moreover, the railroad switch switching position data may contain the locked state or the unlocked state of the railroad switch 51. The inter-station section related data shows whether

The vehicle characteristic data shows structure characteristic and operation characteristic of the vehicle.

[0057]

FIG. 5B is a block diagram showing the configuration of the station I/F device 20 of the signaling system according to the present embodiment. The station storage unit 22 contains station in-station related data 142 at least.

[0058]

The station in-station related data 142 contains data related to the station 3. The station in-station related data 142 is different for every station 3. The station in-station related data 142 contains railroad switch switching position data and inter-station section related data. The railroad switch switching position data shows a switching position of each of a plurality of railroad switches 51 which belong to the station 3, and contains railroad switch command data of each railroad switch 51. The railroad switch command data shows the railroad switch switching command from the train 2 to each of the plurality of railroad switches 51 which belong to the station 3. The railroad switch switching command is a command which instructs the switching of the railroad switch 51, and is related with data of a command source side train 2 and is stored. While the railroad switch switching command is retained, the railroad switch 51 maintains (locks) the switching state. When the railroad switch switching command is erased in response to a railroad switch release command from the command source side train 2, the lock state of the railroad switch 51 is released. The inter-station section related data shows whether or not there is a failure between the station 3 and a neighbor station 3. The railroad

switch command data and the inter-station section related data are transmitted to the on-board device 10 and the operation control device 30, and are stored as the station related data 132 and the center station related data 152.

[0059]

FIG. 5C is a block diagram showing the configuration of the center (CTR.) storage unit 32 of the operation control device 30 of the signaling system according to the present embodiment. The center storage unit 32 contains center (CTR.) operation mode data 150, center (CTR.) train diagram data 151, center (CTR.) station related data 152, center (CTR.) train related data 153 and center (CTR.) basic data 154 at least.

[0060]

The center operation mode data 150 is the same as the operation mode data 130.

[0061]

The center train diagram data 151 contains data showing a train diagram of a railroad line and contains the train diagrams for all the trains 2. The train diagram data may be data of the operation interval.

[0062]

The center station related data 152 contains data related to all stations 3. The center station related data 152 contains the railroad switch switching position data and inter-station section related data of the station in-station related data 142 acquired from all the stations 3. The center station related data 152 are appropriately acquired from the station I/F devices 20 of all the stations 3.

[0063]

The center train related data 153 contains data related to the moving (traveling) of all the

the train 2A has passed through the traveling permission limit position 180B for the rain 2B. The trains 2A and 2B continue the monitoring of the states of the acquired traveling routes and the railroad switch switching positions on the acquired traveling routes until the train 2 on the opposite side has passed through the traveling permission limit position.

[0096]

Next, the train interval protection in case of the inter-station traveling of the train 2 in the operation at the time of occurrence of the failure (the failure mode; the state of the railroad in FIG. 11) will be specifically described.

FIG. 13 is a flow chart showing the operation of the train interval protection in case of inter-station traveling of the train in the operation at the time of occurrence of the failure. The on-board device 10 of the train 2 carries out the traveling route securement and the traveling permission by the train 2 itself based on the exchange of data with the above-mentioned different devices (a plurality of different on-board devices 10, a plurality of station I/F devices 20, and the operation control device 30). Here, the attention should be paid to the on-board device 10 of the train 2A in FIG. 12.

[0097]

The station I/F device 20 of the station 3A (or the station 3B) recognizes that the failure has occurred between the station 3A and the station 3B (failure section 190) by an input of the user or a detection of a sensor, and transmits it to the operation control device 30 of the control center 4 as the station related data (the inter-station section related data (Step S50).

[0098]

CLAIMS

1. A signaling system comprising:

a plurality of on-board devices provided for a plurality of moving vehicles traveling on a track;

a plurality of station interface devices provided for a plurality of stations along the track; and

a plurality of branches provided on the track and controlled by the plurality of station interface devices,

wherein a second on-board device of a second moving vehicle of the plurality of moving vehicles which is on a traveling route of a first moving vehicle of the plurality of moving vehicles transmits different moving vehicle related data which indicates data of the second moving vehicle, to a first on-board device of the first moving vehicle,

wherein a first station interface device of the plurality of station interface devices which controls a branch on the traveling route, transmits station related data which indicates data of the branch on the traveling route, to the first on-board device,

wherein the first on-board device outputs a command for maintenance of a state of the branch on the traveling route or switching and maintenance of the state of the branch to the first station interface device to secure the traveling route based on the different moving vehicle related data and the station related data,

wherein the first station interface device maintains or switches and maintains the state of the branch on the traveling route to secure the traveling route, and

wherein the first on-board device determines the traveling of the first moving vehicle on the

secured traveling route based on the different moving vehicle related data.

2. The signaling system according to claim 1, wherein the first on-board device inquires the different moving vehicle related data to the second on-board device to acquire the different moving vehicle related data, and inquires the station related data to the first station interface device to acquire the station related data.

3. The signaling system according to claim 2, wherein the first on-board device checks whether the traveling route has been secured, based on the station related data and the different moving vehicle related data, and outputs a command to the first station interface device when the traveling route has not been secured.

4. The signaling system according to any one of claims 1 to 3, the different moving vehicle related data includes traveling permission limit position data indicating a range where the moving vehicle succeeding to the second moving vehicle is permitted to travel, and

wherein the first on-board device determines the traveling of the first moving vehicle in the range where the traveling is permitted, based on the traveling permission limit position data.

5. The signaling system according to any one of claims 1 to 4, further comprising:

a radio LAN configured to connect the plurality of on-board devices and the plurality of station interface devices to be bi-directionally communicable,

wherein the first on-board device acquires the different moving vehicle related data and the station related data through the radio LAN.

6. A control method of a moving vehicle by using a signaling system, wherein the signaling system comprises:

a plurality of on-board devices provided for a plurality of moving vehicles which travel on a track;

a plurality of station interface devices provided for a plurality of stations along the track; and

a plurality of branches provided on the track and controlled by the plurality of station interface devices,

wherein the control method of the moving vehicle, comprises:

transmitting different moving vehicle related data which indicates data of a second moving vehicle, to a first on-board device of a first moving vehicle from a second on-board device of the second moving vehicle which is on a traveling route of the first moving vehicle of the plurality of moving vehicles;

transmitting station related data which indicates data of a branch on the traveling route, to the first on-board device from a first station interface device, which controls the branch on the traveling route, of the plurality of station interface devices;

outputting a command for maintenance or switching and maintenance of a state of the branch on the traveling route to the first station interface device from the first on-board device to secure the traveling route based on the different moving vehicle related data and the station related data;

securing the traveling route by maintaining or switching and maintaining the state of the branch on the traveling route by the first station interface device; and

determining the traveling of the moving vehicle on the secured traveling route by the first on-board device based on the different moving vehicle related data.

7. The control method of the moving vehicle according to claim 6, wherein the securing the traveling route comprises:

inquiring the different moving vehicle related data to the second on-board device from the first on-board device to acquire the different moving vehicle related data; and

inquiring the station related data to the first station interface device from the first on-board device to acquire the station related data.

8. The control method of the moving vehicle according to claim 7, wherein the outputting the command comprises:

checking whether the traveling route has been secured, based on the station related data and the different moving vehicle related data by the first on-board device, and outputting the command to the first station interface device when the traveling route has not been secured.

9. The control method of the moving vehicle according to any one of claims 6 to 8, wherein the different moving vehicle related data includes traveling permission limit position data indicating a range where the first moving vehicle succeeding to the second moving vehicle is permitted to travel, and

wherein the determining the traveling comprises:

determining the traveling of the moving vehicle in the range where the traveling is permitted, based on the traveling permission limit position data by the first on-board device.

10. The control method of the moving vehicle according to any one of claims 6 to 9, further comprising:

acquiring the different moving vehicle related data and the station related data through a radio LAN by the first on-board device.

ATP ground device 232, a station control device 234 and an interlocking device 236. The respective devices are mutually connected by an exclusive-use LAN (Local Area Network) 238 to be bi-directionally communicable. The operation control device 230 controls the whole operation. The interlocking device 236 carries out the protection of traveling routes of the trains. The ATP ground device 232 prevents a collision between the trains. The station control device 234 attains the function safety of the control of the opening/closing of platform screen doors and train doors at a station.

[0004]

Each of the (group of) trains is provided with an on-board device 210. The on-board device 210 controls the operation of the train based on the control of the control center. The on-board device 210 is connected with the ATP ground device 232 by the exclusive-use LAN 238 to be bi-directionally communicable. The station is provided with a remote I/O 220. The remote I/O 220 carries out the opening/closing control of the platform screen door 240 and the control of railroad switches 250 on the railroad track based on the control of the control center. The remote I/O 220 is connected with the station control device 234 and the interlocking device 236 by an exclusive-use LAN to be bi-directionally communicable.

[0005]

The operation of this conventional signaling system (the operation of a train) becomes as described below, for example.

When a departure time of an optional train comes gets closer based on the train diagram, the operation control device 230 refers to the on-rail state 205 from the ATP ground device 232 to check the

with a CPU (Central Processing Unit), a storage section, an input section, an output section and an interface, which are not shown. The center control device 31 executes information processing for the operation control device 30. The center storage unit 32 is a storage unit which is exemplified by a hard disk drive, RAM (Random Access Memory) and ROM (Read Only Memory), and stores data and a software program which are used in the center control device 31, and data and a software program which are outputted from the center control device 31. The center communication device 33 is a radio LAN transmitting and receiving unit which carries out a data communication through the general-purpose LAN 60. The center communication device 33 transmits data and the software program which are outputted from the center control device 31, to the on-board device 10 and the station I/F device 20, and receives data and the software program which are transmitted from the on-board device 10 and the station I/F device 20 to output to the center control device 31.

[0036]

The general-purpose LAN 60 is provided with a plurality of base stations 61. The plurality of base stations 61 are arranged in the control center 4 and each station 3 and at a plurality of locations along the railroad track 50. The base station 61 mediates a radio communication among the operation control device 30, the plurality of the on-board devices 10 and the plurality of the station I/F devices 20 to allow data to be sent and received among them. Note that in the present embodiment, an example using the radio LAN as the communication means is shown. However, different communication means may be used if it is possible to send and receive data among them.

[0037]

showing the train diagram of the train 2. The train diagram data 131 is supplied from the operation control device 30 and is different for every train 2. However, the train diagram data 131 may contain only the train diagram of the train 2 and the neighbor train 2. Or, the train diagram data may be data of an operation interval.

[0054]

When the train 2 is in a stop state, the station related data 132 contains data related to a current station (hereinafter, to be referred to as the station 3A) at which the train 2 is in the stop state, data related to the next station as the station 3 (hereinafter, to be referred to as the station 3B) for the train to be stopped next, data related to a previous station as the station 3 (hereinafter, to be referred to as the station 3C) for the train to have been stopped last time. When the train 2 is traveling, the station related data 132 contains data related to the previous station as the station 3 for the train 2 to have departed and data related to the next station as the station 3. The station related data 132 is updated appropriately (e.g. regularly) and is different for every train 2. The station related data 132 contains the railroad switch switching position data and the inter-station section state data. The railroad switch switching position data shows a switching position of each of the plurality of railroad switches 51 which belongs to the targeted stations 3A, 3B and 3C (the previous station, the current station, the next station), and contains the railroad switch command data (to be described later) of each railroad switch 51. Moreover, the railroad switch switching position data may contain the locked state or the unlocked state of the railroad switch 51. The inter-station section state data shows whether

The vehicle characteristic data shows structure characteristic and operation characteristic of the vehicle.

[0057]

FIG. 5B is a block diagram showing the configuration of the station I/F device 20 of the signaling system according to the present embodiment. The station storage unit 22 contains station in-station related data 142 at least.

[0058]

The station in-station related data 142 contains data related to the station 3. The station in-station related data 142 is different for every station 3. The station in-station related data 142 contains railroad switch switching position data and inter-station section state data. The railroad switch switching position data shows a switching position of each of a plurality of railroad switches 51 which belong to the station 3, and contains railroad switch command data of each railroad switch 51. The railroad switch command data shows the railroad switch switching command from the train 2 to each of the plurality of railroad switches 51 which belong to the station 3. The railroad switch switching command is a command which instructs the switching of the railroad switch 51, and is related with data of a command source side train 2 and is stored. While the railroad switch switching command is retained, the railroad switch 51 maintains (locks) the switching state. When the railroad switch switching command is erased in response to a railroad switch release command from the command source side train 2, the lock state of the railroad switch 51 is released. The inter-station section state data shows whether or not there is a failure between the station 3 and a neighbor station 3. The railroad switch command data and the inter-

station section state data are transmitted to the on-board device 10 and the operation control device 30, and are stored as the station related data 132 and the center station related data 152.

[0059]

FIG. 5C is a block diagram showing the configuration of the center (CTR.) storage unit 32 of the operation control device 30 of the signaling system according to the present embodiment. The center storage unit 32 contains center (CTR.) operation mode data 150, center (CTR.) train diagram data 151, center (CTR.) station related data 152, center (CTR.) train related data 153 and center (CTR.) basic data 154 at least.

[0060]

The center operation mode data 150 is the same as the operation mode data 130.

[0061]

The center train diagram data 151 contains data showing a train diagram of a railroad line and contains the train diagrams for all the trains 2. The train diagram data may be data of the operation interval.

[0062]

The center station related data 152 contains data related to all stations 3. The center station related data 152 contains the railroad switch switching position data and inter-station section state data of the station in-station related data 142 acquired from all the stations 3. The center station related data 152 are appropriately acquired from the station I/F devices 20 of all the stations 3.

[0063]

The center train related data 153 contains data related to the moving (traveling) of all the

the train 2A has passed through the traveling permission limit position 180B for the rain 2B. The trains 2A and 2B continue the monitoring of the states of the acquired traveling routes and the railroad switch switching positions on the acquired traveling routes until the train 2 on the opposite side has passed through the traveling permission limit position.

[0096]

Next, the train interval protection in case of the inter-station traveling of the train 2 in the operation at the time of occurrence of the failure (the failure mode; the state of the railroad in FIG. 11) will be specifically described.

FIG. 13 is a flow chart showing the operation of the train interval protection in case of inter-station traveling of the train in the operation at the time of occurrence of the failure. The on-board device 10 of the train 2 carries out the traveling route securement and the traveling permission by the train 2 itself based on the exchange of data with the above-mentioned different devices (a plurality of different on-board devices 10, a plurality of station I/F devices 20, and the operation control device 30). Here, the attention should be paid to the on-board device 10 of the train 2A in FIG. 12.

[0097]

The station I/F device 20 of the station 3A (or the station 3B) recognizes that the failure has occurred between the station 3A and the station 3B (failure section 190) by an input of the user or a detection of a sensor, and transmits it to the operation control device 30 of the control center 4 as the station related data (the inter-station section state data (Step S50).

[0098]

CLAIMS

1. A signaling system comprising:

a plurality of on-board devices provided for a plurality of moving vehicles traveling on a track, and including a first on-board device and a second on-board device, the plurality of moving vehicles including a first moving vehicle and a second moving vehicle;

a plurality of station interface devices provided for a plurality of stations along the track, and including a first station interface device and a second station interface device; and

a plurality of branches provided on the track and controlled by the plurality of station interface devices,

wherein the second on-board device of the second moving vehicle which is on a traveling route of the first moving vehicle transmits different moving vehicle related data which indicates data of the second moving vehicle, to the first on-board device of the first moving vehicle,

wherein the first station interface device which controls one of the plurality of branches, transmits station related data which indicates data of the one branch on the traveling route, to the first on-board device,

wherein the first on-board device outputs a command for maintenance of a state of the one branch on the traveling route or switching and maintenance of the state of the one branch to the first station interface device to secure the traveling route based on the different moving vehicle related data and the station related data,

wherein the first station interface device maintains or switches and maintains the state of the one branch on the traveling route to secure the

traveling route, and

wherein the first on-board device determines the traveling of the first moving vehicle on the secured traveling route based on the different moving vehicle related data.

2. The signaling system according to claim 1, wherein the first on-board device inquires the different moving vehicle related data to the second on-board device to acquire the different moving vehicle related data, and inquires the station related data to the first station interface device to acquire the station related data.

3. The signaling system according to claim 2, wherein the first on-board device checks whether the traveling route has been secured, based on the station related data and the different moving vehicle related data, and outputs a command to the first station interface device when the traveling route has not been secured.

4. The signaling system according to any one of claims 1 to 3, the different moving vehicle related data includes traveling permission limit position data indicating a range where the first moving vehicle succeeding to the second moving vehicle is permitted to travel, and

wherein the first on-board device determines the traveling of the first moving vehicle in the range where the traveling is permitted, based on the traveling permission limit position data.

5. The signaling system according to any one of claims 1 to 4, further comprising:

a radio LAN configured to connect the

plurality of on-board devices and the plurality of station interface devices to be bi-directionally communicable,

wherein the first on-board device acquires the different moving vehicle related data and the station related data through the radio LAN.

6. A control method of a moving vehicle by using a signaling system, wherein the signaling system comprises:

a plurality of on-board devices provided for a plurality of moving vehicles which travel on a track, and including first and second on-board devices, the plurality of moving vehicles including first and second moving vehicles;

a plurality of station interface devices provided for a plurality of stations along the track, and including first and second station interface devices; and

a plurality of branches provided on the track and controlled by the plurality of station interface devices,

wherein the control method of the moving vehicle, comprises:

transmitting different moving vehicle related data which indicates data of the second moving vehicle, to the first on-board device of the first moving vehicle from the second on-board device of the second moving vehicle which is on a traveling route of the first moving vehicle;

transmitting station related data which indicates data of one of the plurality of branches on the traveling route, to the first on-board device from the first station interface device, which controls the one branch on the traveling route;

outputting a command for maintenance or

switching and maintenance of a state of the one branch on the traveling route to the first station interface device from the first on-board device to secure the traveling route based on the different moving vehicle related data and the station related data;

securing the traveling route by maintaining or switching and maintaining the state of the one branch on the traveling route by the first station interface device; and

determining the traveling of the first moving vehicle on the secured traveling route by the first on-board device based on the different moving vehicle related data.

7. The control method of the moving vehicle according to claim 6, wherein the securing the traveling route comprises:

inquiring the different moving vehicle related data to the second on-board device from the first on-board device to acquire the different moving vehicle related data; and

inquiring the station related data to the first station interface device from the first on-board device to acquire the station related data.

8. The control method of the moving vehicle according to claim 7, wherein the outputting the command comprises:

checking whether the traveling route has been secured, based on the station related data and the different moving vehicle related data by the first on-board device, and outputting the command to the first station interface device when the traveling route has not been secured.

9. The control method of the moving vehicle

according to any one of claims 6 to 8, wherein the different moving vehicle related data includes traveling permission limit position data indicating a range where the first moving vehicle succeeding to the second moving vehicle is permitted to travel, and

wherein the determining the traveling comprises:

determining the traveling of the first moving vehicle in the range where the traveling is permitted, based on the traveling permission limit position data by the first on-board device.

10. The control method of the moving vehicle according to any one of claims 6 to 9, further comprising:

acquiring the different moving vehicle related data and the station related data through a radio LAN by the first on-board device.