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Description

Technical Field

[0001] The present invention relates to a train operation management system for controlling a route of a train moving on a track.

Background Art

[0002] International patent publication number WO2018/001674A discloses a method for securing a railroad crossing, comprising detection of sensor data relating to a rail-borne vehicle approaching the crossing by a track-side sensor, transmitting the sensor data to a stationary control device, which determines a switch-on time, taking into account the transmitted sensor data and route data, upon reaching the switch-on time the securing of the railroad crossing is initiated by the stationary control device, after the crossing has been secured a travel permission is determined by a control device of a train control system and transmitted to the rail-borne vehicle to replace previous travel permission that expired prior to reaching the crossing. JP-A-2000-229574 discloses an operation management apparatus including an interlocking device state receiving unit that receives information from an interlocking device, a route control determining unit that determines route control based on the information of the interlocking device from the interlocking device state receiving unit, a facility state receiving unit that receives an existence of a train on a track circuit together with time information, and a route control command unit that issues a route control command. In order to allow the train to travel to a destination position, the operation management apparatus performs operation management to prevent another train from traveling in a route-locked section by setting the track circuit on a route in a locked state.

[0003] In the operation management apparatus of JP-A-2000-229574, in a case where a preceding train up to the destination position is locked in a route, once a position at which a route of a next train conflicts with the route of the preceding train exists, the next train needs to wait until the route-locking of the preceding train is released. Then, since the route-locking of the preceding train is released, and the route-locking of a route in which the next train travels is performed, the operation control is performed to allow the next train to enter the route.

[0004] However, in the operation management apparatus of JP-A-2000-229574, even though it is obvious that the next train is able to pass through a conflicting section in the route earlier than the preceding train, since a train that has secured the route earlier takes precedence, the next train needs to wait at a predetermined position until the train, which has secured the route, passes through the route-locked section.

[0005] Furthermore, in the operation management ap-

paratus of JP-A-2000-229574, since a section for ensuring the route is a unit of the track circuit, there is also a problem that it is impossible to perform operation control of setting a route from a position of the own train on the track to an optional position in a locked state.

[0006] To solve the aforementioned problem, an object of the present invention is to provide a train operation management system that performs operation management control of locking an optional section on a track in a route and preferentially route-locking a train first attempting to pass through a passage section, to be allowed to pass therethrough.

Summary of the Invention

[0007] In order to achieve the object, the present invention provides a train operation management system as set out in the claims appended hereto.

[0008] According to the train operation management system of the invention, by repeating the operation management control such that each train locks only an occupied section up to a trouble point first existing on the route, in the route, sets a stop determination position, and travels in the occupied section, unnecessary passage waiting is prevented based on the route-locking by the other train, so that, without the passage waiting, the own train is able to travel in a section which the own train is able to pass through until the other train arrives, and it is possible to safely move each train to the arrival point.

[0009] Also, since the operation management control of each train is performed on the software of the operation management apparatus, it is possible to set optional positions as a starting point and an arrival point.

Brief Description of the Drawings

[0010]

Fig. 1 is a system configuration diagram of a train operation management system.

Fig. 2 is an explanatory diagram of a point machine disposed in a track.

Fig. 3 is a flowchart diagram of the operation control of an operation management apparatus.

Fig. 4 is a route map on which a starting point and an arrival point of the own train are set.

Fig. 5 is a route map when a first trouble point is extracted.

Fig. 6 is a route map when a trouble point occurring at a railroad crossing is interrupted on the route map of Fig. 5.

Fig. 7 is a route map in a state where an occupied section up to a next trouble point is locked at a stop determination position in the route.

Fig. 8 is a route map when an occupied section of another train exists and the own train arrives at the stop determination position.

Fig. 9 is a route map when the own train stops before

a trouble point due to the occupied section by another train.

Fig. 10 is a route map in a state where an occupied section of another train exists and the own train locks the occupied section up to the trouble point in the route.

Fig. 11 is a route map in a state where the own train locks an occupied section up to the trouble point that is another train, in the route.

Fig. 12 is a route map in a state where an occupied section up to the trouble point moved by the own train is locked in the route.

Fig. 13 is a route map when a trouble point occurring at a railroad crossing is interrupted on a route map in Fig. 5 as a modified example.

Mode for Carrying Out the Invention

[0011] The invention will be described in detail, by way of example, based on the embodiments illustrated in the drawings.

[0012] Fig. 1 is a configuration diagram of a train operation management system according to this embodiment. This train operation management system includes: a train 10 traveling on a track R; a central control unit 20 that performs communication control with a ground apparatus installed in the vicinity of each train 10 and the track R; a point machine 30 and a railroad crossing apparatus 40 that are connected to the central control unit 20 and that are a ground apparatus; and a radio communication unit 50 that is connected to the central control unit 20 and performs communication with each train 10 through a radio communication line.

[0013] The point machine 30 and the railroad crossing apparatus 40, and the central control unit 20 are connected to a first communication network L1, and the radio communication unit 50 and the central control unit 20 are connected to a second communication network L2.

[0014] Although the first communication network L1 and the second communication network L2 are illustrated as a wired network, they may be wireless networks, and the first communication network L1 and the second communication network L2 may be a single network.

[0015] A radio communication unit 50, which is a base station having a communication area in a predetermined range, is installed, for example, at each of certain distance intervals, and by partially overlapping communication areas, communication between the train 10 and the central control unit 20 is prevented from being interrupted. In the communication between the train 10 and the central control unit 20, it is possible to perform communication using a loop antenna and a leaking coaxial cable laid along the track R as the radio communication unit 50, in addition to performing communication through the radio communication line.

[0016] The train 10 is provided with an antenna unit 11 for transmitting and receiving various types of information to and from the radio communication unit 50, and an on-

vehicle apparatus 12 connected to the antenna unit 11. On-vehicle information including a train ID, a traveling speed and a traveling position, and the like of the train 10, to be processed by the on-vehicle apparatus 12 is transmitted to the central control unit 20, through the antenna unit 11 and the radio communication unit 50 at any time.

[0017] The traveling speed of on-vehicle information is calculated based on, for example, the number of revolutions detected by a tachometer attached to an axle. Also, the traveling position is calculated, for example, in kilometers. Alternatively, a GPS terminal may be mounted so that latitude and longitude information may be transmitted as the traveling position. Furthermore, the on-vehicle apparatus 12 performs speed control and the like of the train 10, according to command information such as speed control information transmitted from the central control unit 20.

[0018] The central control unit 20 installed at a station or the like in the train operation management system includes an operation management apparatus 21 connected to the first communication network L1 and the second communication network L2 and an operation terminal 22 connected to the operation management apparatus 21 and operated by an operator.

[0019] The operation management apparatus 21 is a so-called server apparatus, incorporating an arithmetic processing unit and a storage unit (not illustrated). The operation management apparatus 21 receives various types of information from the train 10, the point machine 30 and the railroad crossing apparatus 40 at any time, stores the various types of information thereof in the storage unit, and transmits various types of command information to the train 10 and the point machine 30 at any time, through arithmetic processing of the operation management control by the arithmetic processing unit to be described later.

[0020] The operation terminal 22 is a so-called client apparatus connected to the operation management apparatus 21. By means of a route map or the like displayed on a monitor apparatus (not illustrated), the operation terminal 22 is able to monitor a position and an operation management state of each train based on the on-vehicle information from each train 10, and a state of the ground apparatus such as a locked state of the point machine 30, at any time. Furthermore, it is possible to perform various types of setting processing and the like by an operator through an input unit such as a keyboard and a mouse (not illustrated).

[0021] The point machine 30 includes a changeover unit 31 for moving a switch rail of a branch point of the track R, and a locking lock unit 32 for maintaining the locked state by issuing an operation command to the changeover unit 31.

[0022] The locking lock unit 32 is connected to the operation management apparatus 21 of the central control unit 20 through the first communication network L1. Then, the locking lock unit 32 performs a changeover operation on the changeover unit 31 based on the com-

mand information from the operation management apparatus 21, and transmits locking lock information indicating the locked state of a normal position or an opposite position to be described later, to the operation management apparatus 21 of the central control unit 20.

[0023] Fig. 2 is an explanatory diagram of point machines 30a and 30b disposed at the branch point of the track R. The point machine 30a is disposed at a position where a main track R1 and a sub track R2 are joined, and the point machine 30b is disposed at a position where a sub track R3 branches from the main track R1.

[0024] The point machines 30a and 30b are disposed such that the locked state is at a normal position relative to a central linear main track R1. The state of the normal position is a state in which the switch rail is changed such that the train 10 goes straight along the main track R1, and conversely, a state in which the switch rail is changed such that the train 10 proceeds to the sub tracks R2 and R3 on sides branching from the main track R1 is referred to as the locked state of the opposite position.

[0025] Also, the diagonal lines as illustrated at the installed positions of the point machines 30a and 30b represent a normal position side, and the arrows indicate the locked state of the current normal position and opposite position. Therefore, Fig. 2 illustrates in the explanatory diagram that both of the point machines 30a and 30b are locked in the state of the normal position.

[0026] Fig. 3 is a flowchart of the operation management control of the train 10 in the operation management apparatus 21 of the central control unit 20. As illustrated in Fig. 4, for example, the operation management control for the own train 10a in a case where the own train 10a exists in the sub track R2 will be described based on the flowchart illustrated in Fig. 3.

[0027] On-vehicle information transmitted from each train 10 including the own train 10a and locking lock information transmitted from the point machine 30 are stored in the storage unit of operation management apparatus 21 of the central control unit 20. Then, the arithmetic processing unit of the operation management apparatus 21 performs the operation management control to transmit the command information to each train 10 including the own train 10a on the track at any time, or to transmit command information for locking control, and changeover of the point machine 30, so that it is possible to safely operate the own train 10a up to the arrival point that is a set destination.

[0028] After the operation management apparatus 21 of the central control unit 20 starts an operation management control program which is the flowchart of the operation management control, in step ST1 of Fig. 3, first, a starting point A and an arrival point B in the traveling direction of the own train 10a are set and a route is extracted.

[0029] This setting may be input by operating a monitor screen using the operation terminal 22, or conditions may be input to the operation management apparatus 21 in advance. The starting point A may be a traveling position

on the track where the own train 10a exists, and in this case, only the arrival point B is input. After setting the starting point A and the arrival point B in this manner, the arithmetic processing unit of the operation management apparatus 21 extracts a route traveling on the track R up to the arrival point B.

[0030] Subsequently, the processing proceeds to step ST2, in which the own train 10a travels on the extracted route, trouble positions that hinder traveling are extracted, and among these trouble positions, a trouble position first existing on the route, after departing from the starting point A that is the current position of the own train 10a, is extracted as a trouble point S.

[0031] It is possible to divide this trouble point S into a mobile trouble point Sa that moves on the track like another train 10 and a stationary trouble point Sb that stays stationary at a position on the track. Incidentally, in a case where there is not one of a mobile trouble point Sa and a stationary trouble point Sb up to the arrival point B, the arrival point B is extracted as a trouble point S.

[0032] On the track R where the own train 10a travels, the mobile trouble point Sa corresponds to another train 10b approaching or the other train 10c preceding the own train, so that the position of the trouble point moves on the track R over time. Also, in addition to processing of another train 10 itself as the mobile trouble point Sa, it is also possible to process an occupied section T occupied by the other train 10 as the mobile trouble point Sa.

[0033] On the other hand, the stationary trouble point Sb such as the point machine 30 stays stationary at a predetermined position on the track R. Furthermore, the stationary trouble point Sb is a trouble point Sc based on the point machine 30, a trouble point Sd occurring at a railroad crossing F where the railroad crossing apparatus 40 is installed, and a trouble point Se occurring at a position where crossing of the track R occurs in a cross shape, and so on. Also, the stationary trouble point Sb is not limited thereto, but may include any trouble point appropriately occurring that is detectable on the track R.

[0034] In the trouble point Sc based on the point machine 30, it is changed whether or not a certain point is extracted as the trouble point Sc according to the locked state of the normal position and the opposite position relative to the traveling direction. In a state where the traveling direction according to the locked state of the normal position and the opposite position of the point machine 30 does not coincide with the traveling direction of the train 10, that is, in a case where it is impossible to pass through the point machine 30 in the current locked state of the point machine 30, a certain point is extracted as the trouble point Sc, and the trouble point Sc occurs at a predetermined position on the track R provided on a train 10 side of the point machine 30.

[0035] Conversely, in a state where the traveling direction according to the locked state of the normal position and the opposite position of the point machine 30 coincides with the traveling direction of the train 10, that is, in a case where it is possible to pass through the point ma-

chine 30 in the current locked state, a certain point is not extracted as the trouble point Sc.

[0036] In this way, the own train 10a travels on the track R, and in a case where positions where crossing of the point machine 30, the railroad crossing F and the track R occurs in a cross shape are in a state of hindering traveling, these positions are extracted as trouble positions, and a trouble position first existing on the track R from the current position of the own train 10a is extracted as a trouble point S. Also, in a case of not hindering the own train 10a from traveling, the positions will not be extracted as a trouble position and a trouble point S.

[0037] Fig. 5 is a route map when the trouble point S is extracted as the trouble point Sc based on the route in step ST2 of Fig. 3 and the point machine 30. It is understood that the point machine 30a in front of the own train 10a is maintained in the state of the normal position from the direction of an arrow indicating the current locked state of the normal position and the opposite position.

[0038] Therefore, since the locked state of the point machine 30a is different from the locked state of the opposite position which corresponds to the traveling direction of the own train 10a, the point machine 30a is determined to be the trouble point Sc that is the first trouble position on the route of the own train 10a, and corresponds to a trouble point S. Once this trouble point S is set at a position before the point machine 30a, and is confirmed and set as the trouble point S to be described later, the trouble point is presented as a triangular mark for representing the trouble point S on the sub track R2.

[0039] Also, the trouble point Sd occurring at the aforementioned railroad crossing F is a trouble point occurring in response to an emergency signal being transmitted from the railroad crossing apparatus 40 to the central control unit 20, when an object is detected in the line by an object detector or the like, after a crossing gate, which operates as the own train 10a approaches the railroad crossing F, completely shuts off the passage of vehicles or passersby.

[0040] Alternatively, by pressing an emergency button provided at the railroad crossing F, the emergency signal is transmitted from the railroad crossing apparatus 40 to the central control unit 20, and a trouble position occurs. In a case where this trouble position is extracted as a trouble point S first existing on the route, the trouble point occurs at a predetermined position on the track R on the own train 10a side of the railroad crossing F, as the trouble point Sd. In a case where the trouble position is confirmed and set as a trouble point S that is the first trouble position, the trouble point is presented as a triangular mark on the track, similarly to the trouble point Sc.

[0041] Also, the trouble point Se occurring at a position where crossing of the track R occurs in a cross shape, is a trouble point occurring in a case where a crossing track crossing the track R, on which the own train 10a travels, exists and this crossing track is locked by another train 10 in the occupied section T on the route. This trouble point Se occurs at a predetermined position on the track R

provided on the own train 10a side of the crossing position, and once the trouble point is confirmed and set as a trouble point S, the trouble point is presented as a triangular mark on the track, similarly to the trouble point Sc.

[0042] These stationary trouble points Sb, of which occurring positions stay stationary in advance, are managed by the operation management apparatus 21, so as to be located at a predetermined distance, for example, 30 meters before positions where crossing of installed positions of the point machines 30a and 30b, the installed position of the railroad crossing F, and the track R occurs in a cross shape.

[0043] Similarly, the operation management apparatus 21 will manage the mobile trouble point Sa to be located at, for example, 30 meters before the leading end of another train 10b in the case of the approaching vehicle, and to be located at, for example, 30 meters behind the rear end of still another train 10c in the case of the preceding vehicle.

[0044] In this way, after extracting the trouble point S that is the first trouble position, the processing proceeds to step ST3 in Fig. 3. Then, it is determined in step ST3 whether or not a route up to the trouble point S is occupiable. Incidentally, the occupancy of the route does not mean a locked state based on a track circuit using the track R in the related art, but may mean locking a route on software.

[0045] Then, in a case where the route up to the trouble point S is occupiable, the processing proceeds to step ST4 in Fig. 3, where the route from the starting point A to the trouble point S is occupied, and only the occupied section T is locked in the route.

[0046] Conversely, for some reasons, in a case where the route up to the trouble point S is not occupiable, for example, in a case where a distance to the trouble point S is very short, and the like, it is not possible to proceed to step ST4 in Fig. 3, and by performing repetition from the extraction processing of the trouble point S in step ST2 to the occupancy determination processing in step ST3, the own train 10a waits until the route up to the trouble point is occupiable.

[0047] Since the own train 10a locks a section from the starting point A to the trouble point S in the route as the occupied section T1 illustrated in Fig. 5, the own train 10a is able to enter the occupied section T1.

[0048] Then, for the occupied section T1 locked by the own train 10a in the route, in order to prevent another train 10 from entering the occupied section T1, the operation control is performed not to permit the other train 10 to set and lock an occupied section T including part or all of the occupied section T1.

[0049] Therefore, the other train 10 is not able to set a route including part or all of the occupied section T1 as the occupied section T, until the own train 10a passes through the occupied section T1 and the occupied section T1 is released.

[0050] Once a section up to the trouble point S is locked in the route as the occupied section T1, the trouble point is

presented as a triangular mark representing a trouble point S on the sub track R2, and the trouble point S is set.

[0051] Next, the processing proceeds to step ST5 in Fig. 3, and command information for permitting the own train 10a to enter the occupied section T1 is transmitted from the operation management apparatus 21 to the own train 10a, through the radio communication unit 50 and the antenna unit 11.

[0052] Based on the received command information, the own train 10a displays traveling information including a starting point A, an arrival point B, a route and a trouble point S on a monitor apparatus provided in an operator console or the like, and enters into the occupied section T1 and starts traveling.

[0053] Next, the processing proceeds to step ST6 in Fig. 3, and the operation management apparatus 21 performs the setting of a stop determination position P of the trouble point S. The stop determination position P is a position located at a stop distance d before the trouble point S. The stop distance d may be a fixed distance or the stop distance d may be appropriately varied according to a traveling speed and the like of the on-vehicle information transmitted from the own train 10a. This stop distance d is a distance that does not exceed the trouble point S when stopping is executed according to a normal deceleration pattern from the stop determination position P, and is set with some margin in distance.

[0054] Incidentally, in a case where the stop distance d is varied according to the traveling speed of the own train 10a or the like, the operation management apparatus 21 transmits the information of the stop determination position P to the own train 10a at any time. Then, the own train 10a displays information of the received stop determination position P on the monitor apparatus provided in the operator console or the like.

[0055] Next, the processing proceeds to step ST7 in Fig. 3, in which the operation management apparatus 21 of the central control unit 20 monitors whether or not the own train 10a has passed through the stop determination position P located at a predetermined distance before the trouble point S, based on the traveling position of the on-vehicle information transmitted from the own train 10a at any time.

[0056] In a case where the own train 10a arrives at and passes through the stop determination position P, the processing proceeds to step ST8 in Fig. 3. In step ST8, in order to decelerate and perform stop control of the own train 10a, deceleration stop command information for performing deceleration stop processing is transmitted from the operation management apparatus 21 to the own train 10a.

[0057] The own train 10a starts decelerating according to the deceleration pattern or the like stored in the on-vehicle apparatus 12 based on the received deceleration stop command information, and performs deceleration stop processing of stopping before the trouble point S of the point machine 30a.

[0058] Alternatively, the deceleration stop command

information transmitted from operation management apparatus 21 of the central control unit 20 includes the deceleration pattern calculated from the speed, position, and the like of the own train 10a, and the own train 10a may perform deceleration stop processing of stopping before the trouble point S, according to the deceleration pattern of the received deceleration stop command information.

[0059] Next, the processing proceeds to step ST9 in Fig. 3, and it is determined whether or not the own train 10a has arrived at the arrival point B. Once the own train 10a arrives at the arrival point B and has stopped, the operation management apparatus 21 ends the operation management control program.

[0060] Also, in a case where the own train 10a has not arrived at the arrival point B in step ST9 of Fig. 3, the processing proceeds to step ST2 in Fig. 3. In a case where the trouble point S is not released and the trouble point S of the same trouble position continues, the loop processing of step ST2 to step ST9 is repeatedly performed. The own train 10a continues deceleration stop processing of stopping before the point machine 30a that is the latest trouble point S, so that the own train 10a is unable to pass through the point machine 30a.

[0061] In a case where the latest trouble point S is released in the deceleration stop command and a new trouble point S that is a trouble position different from the latest trouble point S is extracted, for this new trouble point S, the processing from step ST2 to step ST7 in Fig. 3 is performed.

[0062] In such a case, in a case where it is impossible to occupy a route up to the new trouble point S in step ST3, the processing from the extraction processing of the trouble point S in step ST2 to the occupancy determination processing in step ST3 is repeatedly performed.

[0063] In a case where it is possible to occupy a route up to the new trouble point S in step ST3, the setting of the latest trouble point S is released. Then, in step ST4, a new occupied section T1 from the current vehicle position to the new trouble point S is locked in the route, and the new trouble point S is set, and then a new stop determination position P is set in step ST6.

[0064] Also, in a case where the own train 10a is not passing through the stop determination position P in step ST7, the processing proceeds to step ST10, in which it is determined whether or not deceleration stop processing is being commanded from the operation management apparatus 21.

[0065] The step ST10 in Fig. 3 is a step for releasing deceleration stop processing from the own train 10a that has not yet passed through the new stop determination position P, when a new trouble point S and a new stop determination position P are set after the deceleration stop processing is commanded from the operation management apparatus 21 in step ST8.

[0066] Then, in step ST10 of Fig. 3, in a case where it is determined that the deceleration stop processing is being commanded from the operation management apparatus

21, the processing proceeds to step ST11. In step ST11, deceleration stop releasing command information for releasing deceleration stop processing is transmitted from the operation management apparatus 21 to the own train 10a. The own train 10a releases the deceleration stop processing based on the received deceleration stop releasing command information, and returns to a normal traveling. Thereafter, the processing returns to step ST2.

[0067] In step ST10 of Fig. 3, also in a case where it is determined that the deceleration stop processing is not being commanded from the operation management apparatus 21, the processing returns to step ST2, and the loop processing of these steps is also repeatedly performed.

[0068] In a case where the own train 10a is not passing through the stop determination position P of the trouble point S, that is, in a case where the own train 10a is traveling toward the stop determination position P, the processing of the step ST2 to the step ST7, and step ST10, and the processing of returning to step ST2 are repeatedly performed, and in this loop processing, as illustrated in Fig. 6, there is a case where the trouble point Sd occurring at the railroad crossing F occurs by interruption before the trouble point Sc in Fig. 5.

[0069] In such a case, the trouble point Sd, which has occurred by interruption, becomes a new trouble point S. At the same time, the occupied section T1 is also changed to the occupied section T up to the trouble point Sd, the setting of the trouble point S before interruption is released, the new occupied section T1 is locked in the route and the new trouble point S is set, and then the new stop determination position P is set, so that the own train 10a travels in the occupied section T1.

[0070] In a case where the trouble point Sd occurring at the railroad crossing F, that is, the trouble point S is not released, the loop processing of steps ST2 to ST9 in Fig. 3 is repeatedly performed, and finally, the own train 10a will stop before the railroad crossing F that is the trouble point S.

[0071] Fig. 7 is a route map when the own train 10a in Fig. 5 travels in the occupied section T1 and arrives at the stop determination position P. The figure indicates a state in which, according to the approach of the own train 10a to the point machine 30a, the point machine 30a is changed from the locked state of the normal position to the locked state of the opposite position, in response to an instruction from the operation management apparatus 21.

[0072] In a case where the own train 10a approaches the point machine 30a on a condition that the point machine 30a does not maintain the locked state of the normal position by the route-locking of the other train 10, in order to make the own train 10a to pass, the operation management apparatus 21 transmits, to the point machine 30a, command information for moving the switch rail of the changeover unit 31, thereby changing the point machine 30a from the locked state of the normal position to the locked state of the opposite position.

[0073] Under the control in this way, the trouble point S of the point machine 30a is released, and according to the repetition from step ST2 to step ST6 in Fig. 3, the trouble point Sc of the point machine 30b will be newly extracted as the next trouble point S.

[0074] A new trouble point S is set by releasing the setting of the trouble point S of point machine 30a and locking the occupied section T1 up to the new trouble point S in the route. Then, a new stop determination position P is set, and the own train 10a starts traveling in the occupied section T1.

[0075] Figs. 8 and 9 are route maps in a state where, at the time when the own train 10a arrives at the stop determination position P, for example, another train 10b traveling from a sub track R3 direction toward a sub track R2 direction has already locked an occupied section T2 that is an occupied section T, in the route, to travel on the main track R1.

[0076] In a case where the other train 10b has already locked the occupied section T2 of the other train 10b in the route, the own train 10a starts deceleration stop processing after passing through the stop determination position P. Then, as long as the trouble point S of point machine 30a is not released, the own train 10a performs deceleration stop control of stopping before the trouble point S.

[0077] Since the occupied section T2 of the other train 10b is open at any time for allowing the other train 10b to pass therethrough, and the other train 10b passes through the point machine 30a, it is possible to change the point machine 30a from the locked state of the normal position to the locked state of the opposite position.

[0078] According to an instruction from the operation management apparatus 21 of the central control unit 20, the point machine 30a is changed from the locked state of the normal position to the locked state of the opposite position, thereby releasing the trouble point S of the point machine 30a. Then, similarly to the route map in Fig. 7, the trouble point Sc of the point machine 30b is extracted as a new trouble point S.

[0079] The operation management apparatus 21 of the central control unit 20 releases the setting of the trouble point S of the point machine 30a, locks only an occupied section T1 up to a new trouble point S in the route, and sets the new trouble point S, and then a new stop determination position P is set, so that traveling in the occupied section T1 is started.

[0080] Figs. 10 to 12 are route maps in a state where, for example, a starting point A of the own train 10a and an arrival point B on the main track R1 are set, and another train 10c traveling from the sub track R2 direction toward the sub track R3 direction has already occupied an occupied section T3 that is an occupied section T of the other train 10c, to travel on the main track R1.

[0081] The operation management apparatus 21 of the central control unit 20 extracts a trouble point S that is a first trouble position on the route of the own train 10a, locks an occupied section T1 up to the trouble point S in

the route, and sets the trouble point S, and then transmits traveling permission command information from the operation management apparatus 21 to the own train 10a. Upon receiving this command information, the own train 10a starts traveling.

[0082] Then, the stop determination position P is set, and in a case where, when the own train 10a travels and passes through the stop determination position P, the other train 10c is not passing through the point machine 30a, the locked state of the point machine 30a is not changed from the state of the normal position, and the trouble point S is not released. Therefore, the own train 10a will stop before the trouble point S.

[0083] As illustrated in Fig. 11, since the other train 10c passes through the point machine 30a, it is possible to change the point machine 30a from the locked state of the normal position to the locked state of the opposite position. Since, according to the instruction from the operation management apparatus 21, the point machine 30a is changed from the locked state of the normal position to the locked state of the opposite position, the trouble point S of the point machine 30a is released.

[0084] Then, the operation management apparatus 21 extracts a mobile trouble point Sa of the other train 10c as a new trouble point S, and releases the setting of the trouble point S of the point machine 30a. The operation management apparatus 21 locks an occupied section T1 up to the new trouble point S that is the mobile trouble point Sa, in the route, and sets the new trouble point S.

[0085] A new stop determination position P is set, and the own train 10a starts traveling in the occupied section T1. Since this mobile trouble point Sa is moving, the stop determination position P also moves according to the movement of the other train 10c.

[0086] Therefore, in a case where the mobile trouble point Sa is set as a trouble point S, and in a case where the other train 10c that is the mobile trouble point Sa continues to stop, once the own train 10a passes the stop determination position P, the processing proceeds to the step ST8 in which a command for deceleration stop processing is transmitted from the operation management apparatus 21 to the own train 10a.

[0087] Upon receiving the command of the deceleration stop processing, the own train 10a starts deceleration stop processing according to the deceleration pattern and the like stored in the on-vehicle apparatus 12, and the own train 10a also stops before the other train 10c.

[0088] Also, in a case where another stationary trouble point Sb has occurred by interruption while the own train 10a follows the other train 10c, the stationary trouble point Sb is extracted as a new trouble point S.

[0089] On the route map of Fig. 12, once the other train 10c travels as it is, it is expected that the arrival point B, which is the last trouble position, occurs by interruption as a trouble point S, and the occupied section T1 up to the arrival point B is locked in the route, and the arrival point B is set as the trouble point S, and then the stop determina-

tion position P is set, so that the own train 10a is able to arrive at the arrival point B.

Modified Example

[0090] A modified example of the train operation management system will be described by exemplifying a case where a trouble point Sd occurring at the railroad crossing F has occurred by interruption before the trouble point Sc in Fig. 5, for example, as illustrated in Fig. 13. As illustrated in the figure, while the trouble point S, the occupied section T1, and the stop determination position P of the point machine 30a, that have been already set, are maintained as they are, it is considered for the trouble point Sd occurring at the railroad crossing F to perform interruption processing.

[0091] In such a case, the trouble point S of the point machine 30a illustrated in Fig. 13 is not released, and the trouble point Sd, which has occurred by interruption, is set as a trouble point S'. Since the occupied section T1 from the own train 10a to the trouble point S including the trouble point S' is locked in the route, it is not necessary to perform route-locking for the trouble point S', again.

[0092] Therefore, the operation management apparatus 21 sets the stop determination position P' for the trouble point S', and controls a command for deceleration stop processing or a command for releasing deceleration stop processing based on the stop determination position P'.

[0093] Also, in a case where the trouble point S' is released, the operation management apparatus 21 needs not to newly extract the trouble point S of the point machine 30a, needs not to lock the occupied section T1 in the route, and needs not to perform the setting of the trouble point S and the stop determination position P, and the own train 10a is able to return to normal control based on the information of the maintained trouble point S or the like.

[0094] In this way, according to the train operation management system, by repeating the operation management control such that each train 10 locks only an occupied section T1 up to the trouble point S first existing on a route, in the route, sets a stop determination position P, and travels in the occupied section T1, it is possible to prevent unnecessary passage waiting based on the route-locking by another train 10. Then, without the passage waiting, the own train 10a is able to travel in a section which the own train is able to pass through until another train 10 arrives.

[0095] The operation management control is performed such that the route is preferentially locked for the train 10 first arriving at a passage section to pass through the passage section, and each train 10 is able to safely move to the arrival point B.

[0096] Also, since the operation management control of each train 10 is performed on the software of the operation management apparatus 21 without using the track circuit, it is possible to set optional positions as the

starting point A and the arrival point B.

Reference Signs List

[0097]

10	Train	5
10a	Own train	
10b, 10c	Another train	
20	Central control unit	10
21	Operation management apparatus	
22	Operation terminal	
30, 30a, 30b	Point machine	
50	Radio communication unit	15

Claims

1. A train operation management system comprising:

trains (10) including an own train (10a) and another train (10b) traveling on a track (R);
 a ground apparatus installed in the vicinity of the track (R); and
 an operation management apparatus (21) that performs communication control with the trains (10) and the ground apparatus, wherein the operation management apparatus (21) is configured to perform operation management control of setting an occupied section (T) of the own train (10a) by route-locking only a section up to a trouble position, at which the own train (10a) traveling will be hindered, such that it is possible to prevent another train (10b) from entering the occupied section (T) for the trains (10, 10a, 10b) on the track (R), wherein the operation management apparatus (21) is configured to perform operation management control of extracting a route from a starting point (A) of the own train (10a) or a traveling position on the track (R), where the own train (10a) exists, up to an arrival point (B) that is a set destination of the own train (10a) in a case where the arrival point (B) is set, extracting the first trouble position at which the own train (10a) traveling on the route will be hindered as a trouble point (S), and setting the occupied section (T) of the own train (10a) by route-locking only a section up to the trouble point (S), wherein the operation management apparatus (21) is configured to extract the arrival point (B) as the trouble point (S) and sets the occupied section (T) by route-locking only a section up to the arrival point (B), in a case where there is not the trouble point (S) up to the arrival point (B), wherein the operation management apparatus (21) is configured to repeatedly perform extracting the trouble point (S) and setting the occupied section (T) of the own train (10a) until the own

train (10a) arrives at the arrival point (B);
 the operation management apparatus (21) is configured to set the occupied section (T) by route-locking only a section up to a new trouble point (S), in a case where the trouble point (S) is released and the new trouble point (S) is extracted; and
 the operation management apparatus (21) is configured to release the trouble point (S), sets a new trouble point (S) occurring by interruption, and sets the occupied section (T) by route-locking only a section up to the new trouble point (S), in a case where the trouble point (S) is not released and the new trouble point (S) occurs by interruption before the trouble point (S).

2. The train operation management system according to claim 1,

wherein the operation management apparatus (21) is configured to perform operation management control to prevent the own train (10a) from passing through the trouble position (S).

3. The train operation management system according to any one of claims 1 or 2,

wherein in a case where a new trouble point (S) is extracted and in a case where a route up to the new trouble point (S) is unable to be locked, the operation management apparatus (21) is configured to perform operation management control to prevent the own train (10a) from passing through the trouble point (S).

4. The train operation management system according to any one of claims 1 to 3,

wherein, a stop determination position (P) is set at a predetermined distance before the trouble point (S), and the own train (10a) starts deceleration stop control, in a case where the own train (10a) travels in the occupied section (T) and has passed through the stop determination position (P).

5. The train operation management system according to claim 4,

wherein, after passing through the stop determination position (P), in a case where a new trouble point (S) is newly set as the trouble point (S) and the route-locking is performed, the operation management apparatus (21) is configured to perform operation management control of releasing the deceleration stop control of the own train (10a).

6. The train operation management system according to any one of claims 1 to 5,

wherein the trouble point (S) includes a stationary trouble point (Sb) of any one of a trouble point (S) based on a point machine (30) that is the ground apparatus, a trouble point (S) occurring at a railroad

crossing, and a trouble point (S) occurring at a position where crossing of a track (R) occurs in a cross shape.

7. The train operation management system according to any one of claims 1 to 6, wherein the trouble point (S) is a stationary trouble point (Sb) based on the point machine (30) that is the ground apparatus and extracted as the trouble point (S), in a case where a traveling direction of the locked state of the point machine (30) does not coincide with a traveling direction of the own train(10a). 5 10
8. The train operation management system according to any one of claims 1 to 7, wherein the trouble point (S) includes a mobile trouble point (Sa) that is the other train moving on a track (R). 15

Patentansprüche

1. Zugbetriebsleitsystem, umfassend:

Züge (10), die einen eigenen Zug (10a) und einen anderen Zug (10b) beinhalten, die auf einem Gleis (R) fahren; 25
eine Bodeneinrichtung, die in der Nähe des Gleises (R) installiert ist; und
eine Betriebsleiteinrichtung (21), die eine Kommunikationssteuerung mit den Zügen (10) und der Bodeneinrichtung durchführt, wobei die Betriebsleiteinrichtung (21) konfiguriert ist, um eine Betriebsleitsteuerung des Festlegens eines belegten Abschnitts (T) des eigenen Zuges (10a) durch Fahrstraßenverriegelung nur eines Abschnitts bis zu einer Störungsposition, an der der fahrende eigene Zug (10a) behindert wird, durchzuführen, sodass es möglich ist, zu verhindern, dass ein anderer Zug (10b) in den belegten Abschnitt (T) für die Züge (10, 10a, 10b) auf dem Gleis (R) einfährt, wobei die Betriebsleiteinrichtung (21) konfiguriert ist, um eine Betriebsleitsteuerung des Extrahierens einer Route von einem Startpunkt (A) des eigenen Zuges (10a) oder einer Fahrposition auf dem Gleis (R), wo der eigene Zug (10a) vorhanden ist, bis zu einem Ankunftspunkt (B), der ein festgelegtes Ziel des eigenen Zuges (10a) ist, in einem Fall, in dem der Ankunftspunkt (B) festgelegt ist, des Extrahierens der ersten Störungsposition, an der der auf der Route fahrende eigene Zug (10a) behindert wird, als einen Störpunkt (S), und des Festlegens des belegten Abschnitts (T) des eigenen Zuges (10a) durch Fahrstraßenverriegelung nur eines Abschnitts bis zu dem Störpunkt (S) durchzuführen, 30 35 40 45 50 55

wobei die Betriebsleiteinrichtung (21) konfiguriert ist, um den Ankunftspunkt (B) als den Störpunkt (S) zu extrahieren, und den belegten Abschnitt (T) durch Fahrstraßenverriegelung nur eines Abschnitts bis zu dem Ankunftspunkt (B) festlegt, in einem Fall, in dem es den Störpunkt (S) bis zu dem Ankunftspunkt (B) nicht gibt, wobei die Betriebsleiteinrichtung (21) konfiguriert ist, um das Extrahieren des Störpunktes (S) und das Festlegen des belegten Abschnitts (T) des eigenen Zuges (10a) wiederholt durchzuführen, bis der eigene Zug (10a) an dem Ankunftspunkt (B) ankommt; die Betriebsleiteinrichtung (21) konfiguriert ist, um den belegten Abschnitt (T) durch Fahrstraßenverriegelung nur eines Abschnitts bis zu einem neuen Störpunkt (S) festzulegen, in einem Fall, in dem der Störpunkt (S) freigegeben wird und der neue Störpunkt (S) extrahiert wird; und die Betriebsleiteinrichtung (21) konfiguriert ist, um den Störpunkt (S) freizugeben, einen neuen Störpunkt (S), der durch Unterbrechung auftritt, festlegt, und den belegten Abschnitt (T) durch Fahrstraßenverriegelung nur eines Abschnitts bis zu dem neuen Störpunkt (S) festlegt, in einem Fall, in dem der Störpunkt (S) nicht freigegeben wird und der neue Störpunkt (S) durch Unterbrechung vor dem Störpunkt (S) auftritt.

2. Zugbetriebsleitsystem nach Anspruch 1, wobei die Betriebsleiteinrichtung (21) konfiguriert ist, um eine Betriebsleitsteuerung durchzuführen, um zu verhindern, dass der eigene Zug (10a) die Störungsposition (S) durchfährt.
3. Zugbetriebsleitsystem nach einem der Ansprüche 1 oder 2, wobei in einem Fall, in dem ein neuer Störpunkt (S) extrahiert wird, und in einem Fall, in dem eine Route bis zu dem neuen Störpunkt (S) nicht verriegelt werden kann, die Betriebsleiteinrichtung (21) konfiguriert ist, um eine Betriebsleitsteuerung durchzuführen, um zu verhindern, dass der eigene Zug (10a) den Störpunkt (S) durchfährt.
4. Zugbetriebsleitsystem nach einem der Ansprüche 1 bis 3, wobei eine Stoppbestimmungsposition (P) in einer vorbestimmten Entfernung vor dem Störpunkt (S) festgelegt ist, und der eigene Zug (10a) eine Verzögerungsstoppsteuerung startet, in einem Fall, in dem der eigene Zug (10a) in dem belegten Abschnitt (T) fährt und die Stoppbestimmungsposition (P) durchfahren hat.
5. Zugbetriebsleitsystem nach Anspruch 4, wobei nach dem Durchfahren der Stoppbestimmungsposition (P), in einem Fall, in dem ein neuer Störpunkt (S) neu als der Störpunkt (S) festgelegt

wird und die Fahrstraßenverriegelung durchgeführt wird, die Betriebsleiteinrichtung (21) konfiguriert ist, um eine Betriebsleitsteuerung des Freigebens der Verzögerungsstoppsteuerung des eigenen Zuges (10a) durchzuführen.

5

6. Zugbetriebsleitsystem nach einem der Ansprüche 1 bis 5,
wobei der Störpunkt (S) einen stationären Störpunkt (Sb) von einem beliebigen von einem Störpunkt (S) basierend auf einem Weichenantrieb (30), der die Bodeneinrichtung ist, einem Störpunkt (S), der an einem Bahnübergang auftritt, und einem Störpunkt (S), der an einer Position auftritt, an der eine Kreuzung eines Gleises (R) in einer Kreuzform auftritt, beinhaltet. 10
7. Zugbetriebsleitsystem nach einem der Ansprüche 1 bis 6,
wobei der Störpunkt (S) ein stationärer Störpunkt (Sb) basierend auf dem Weichenantrieb (30) ist, der die Bodeneinrichtung ist und als der Störpunkt (S) extrahiert wird, in einem Fall, in dem eine Fahrtrichtung des verriegelten Zustands des Weichenantriebs (30) nicht mit einer Fahrtrichtung des eigenen Zuges (10a) übereinstimmt. 20 25
8. Zugbetriebsleitsystem nach einem der Ansprüche 1 bis 7,
wobei der Störpunkt (S) einen mobilen Störpunkt (Sa) beinhaltet, der der andere Zug ist, der sich auf einem Gleis (R) bewegt. 30

Revendications 35

1. Système de gestion d'exploitation de train comprenant :

des trains (10) comportant un train concerné (10a) et un autre train (10b) circulant sur une voie (R) ;
un appareil au sol installé à proximité de la voie (R) ; et
un appareil de gestion d'exploitation (21) qui réalise la commande de communication avec les trains (10) et l'appareil au sol,
dans lequel l'appareil de gestion d'exploitation (21) est configuré pour réaliser la commande de gestion d'exploitation consistant à définir une section occupée (T) du train concerné (10a) en bloquant l'itinéraire uniquement sur une section jusqu'à une position de problème, au niveau de laquelle la circulation du train concerné (10a) sera entravée, de sorte qu'il soit possible d'empêcher un autre train (10b) d'entrer dans la section occupée (T) pour les trains (10, 10a, 10b) sur la voie (R), 40 45 50 55

dans lequel l'appareil de gestion d'exploitation (21) est configuré pour réaliser la commande de gestion d'exploitation consistant à extraire un itinéraire à partir d'un point de départ (A) du train concerné (10a) ou d'une position de circulation sur la voie (R), où se trouve le train concerné (10a), jusqu'à un point d'arrivée (B) qui est une destination définie du train concerné (10a) dans le cas où le point d'arrivée (B) est défini, à extraire la première position de problème au niveau de laquelle le train concerné (10a) circulant sur l'itinéraire sera entravé comme point de problème (S), et à définir la section occupée (T) du train concerné (10a) en bloquant l'itinéraire uniquement sur une section jusqu'au point de problème (S),

dans lequel l'appareil de gestion d'exploitation (21) est configuré pour extraire le point d'arrivée (B) comme point de problème (S) et définit la section occupée (T) en bloquant l'itinéraire uniquement sur une section jusqu'au point d'arrivée (B), dans le cas où il n'y a pas de point de problème (S) jusqu'au point d'arrivée (B),

dans lequel l'appareil de gestion d'exploitation (21) est configuré pour réaliser de manière répétée l'extraction du point de problème (S) et la définition de la section occupée (T) du train concerné (10a) jusqu'à ce que le train concerné (10a) arrive au point d'arrivée (B) ;

l'appareil de gestion d'exploitation (21) est configuré pour définir la section occupée (T) en bloquant l'itinéraire uniquement sur une section jusqu'à un nouveau point de problème (S), dans le cas où le point de problème (S) est libéré et le nouveau point de problème (S) est extrait ; et l'appareil de gestion d'exploitation (21) est configuré pour libérer le point de problème (S), définit un nouveau point de problème (S) survenant par interruption et définit la section occupée (T) en bloquant l'itinéraire uniquement sur une section jusqu'au nouveau point de problème (S), dans le cas où le point de problème (S) n'est pas libéré et que le nouveau point de problème (S) survient par interruption avant le point de problème (S).

2. Système de gestion d'exploitation de train selon la revendication 1,
dans lequel l'appareil de gestion d'exploitation (21) est configuré pour réaliser la commande de gestion d'exploitation afin d'empêcher le train concerné (10a) de passer par la position de problème (S).
3. Système de gestion d'exploitation de train selon l'une quelconque des revendications 1 ou 2,
dans lequel, dans le cas où un nouveau point de problème (S) est extrait et dans le cas où un itinéraire jusqu'au nouveau point de problème (S) ne peut pas être bloqué, l'appareil de gestion d'exploitation (21)

est configuré pour réaliser la commande de gestion d'exploitation afin d'empêcher le train concerné (10a) de passer par le point de problème (S).

4. Système de gestion d'exploitation de train selon 5
l'une quelconque des revendications 1 à 3,
dans lequel une position de détermination d'arrêt (P)
est définie à une distance prédéterminée avant le
point de problème (S), et le train concerné (10a)
commence la commande d'arrêt de décélération, 10
dans le cas où le train concerné (10a) circule dans
la section occupée (T) et est passé par la position de
détermination d'arrêt (P).

5. Système de gestion d'exploitation de train selon la 15
revendication 4,
dans lequel, après le passage par la position de
détermination d'arrêt (P), dans le cas où un nouveau
point de problème (S) est nouvellement défini
comme point de problème (S) et que le blocage de 20
l'itinéraire est réalisé, l'appareil de gestion d'explo-
itation (21) est configuré pour réaliser la commande
de gestion d'exploitation consistant à libérer la
commande d'arrêt de décélération du train concerné
(10a). 25

6. Système de gestion d'exploitation de train selon
l'une quelconque des revendications 1 à 5,
dans lequel le point de problème (S) comporte un
point de problème stationnaire (Sb) de l'un quel- 30
conque parmi un point de problème (S) sur la base
d'une machine de manœuvre d'aiguille (30) qui est
l'appareil au sol, un point de problème (S) survenant
au niveau d'un passage à niveau, et un point de
problème (S) survenant au niveau d'une position 35
où le croisement d'une voie (R) survient en forme
de croix.

7. Système de gestion d'exploitation de train selon
l'une quelconque des revendications 1 à 6, 40
dans lequel le point de problème (S) est un point de
problème stationnaire (Sb) sur la base de la machine
de manœuvre d'aiguille (30) qui est l'appareil au sol
et extrait comme point de problème (S), dans le cas
où une direction de circulation de l'état bloqué de la 45
machine de manœuvre d'aiguille (30) ne coïncide
pas avec une direction de circulation du train
concerné (10a).

8. Système de gestion d'exploitation de train selon 50
l'une quelconque des revendications 1 à 7,
dans lequel le point de problème (S) comporte un
point de problème mobile (Sa) qui est l'autre train se
déplaçant sur une voie (R). 55

FIG. 1

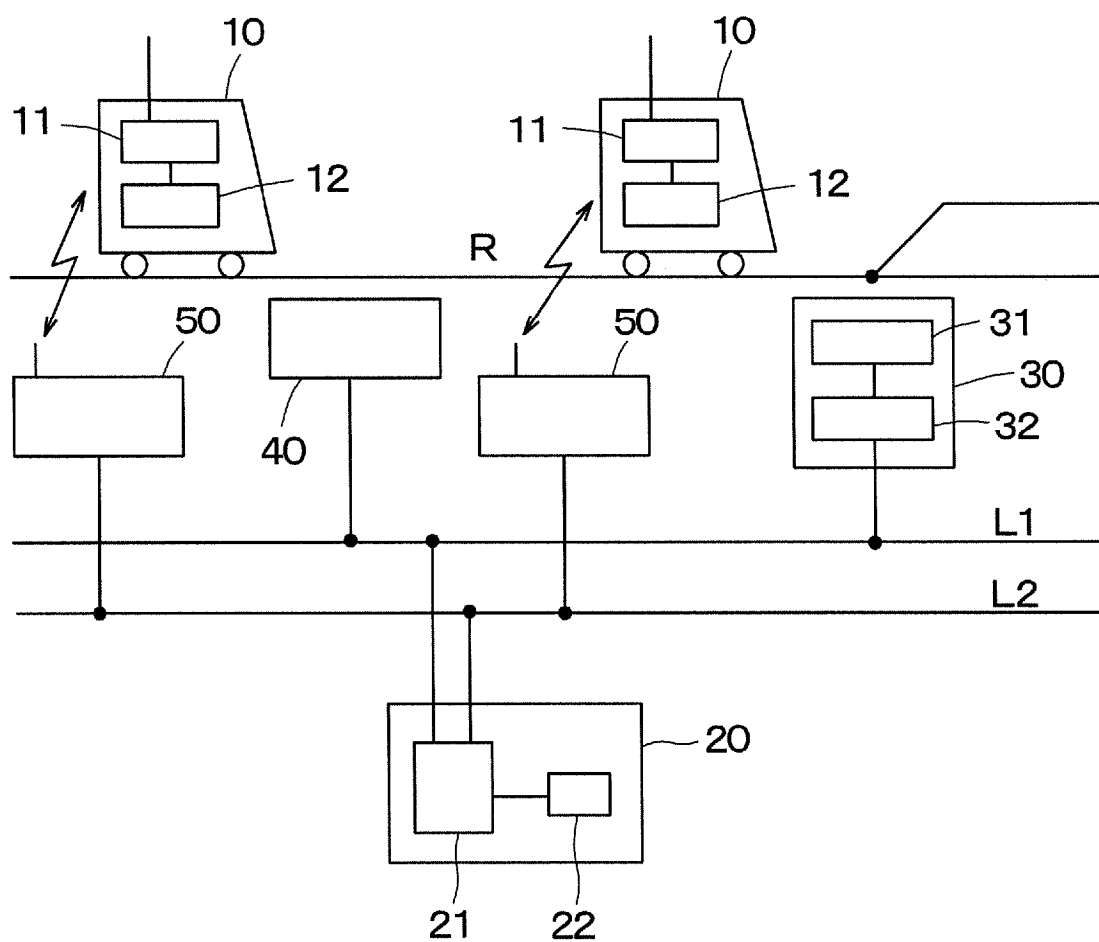


FIG. 2

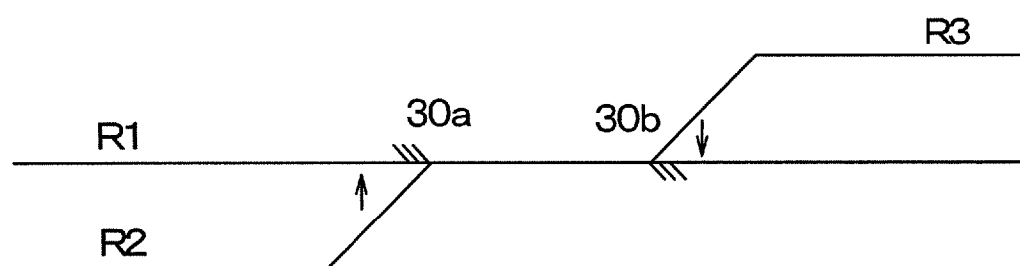


FIG. 3

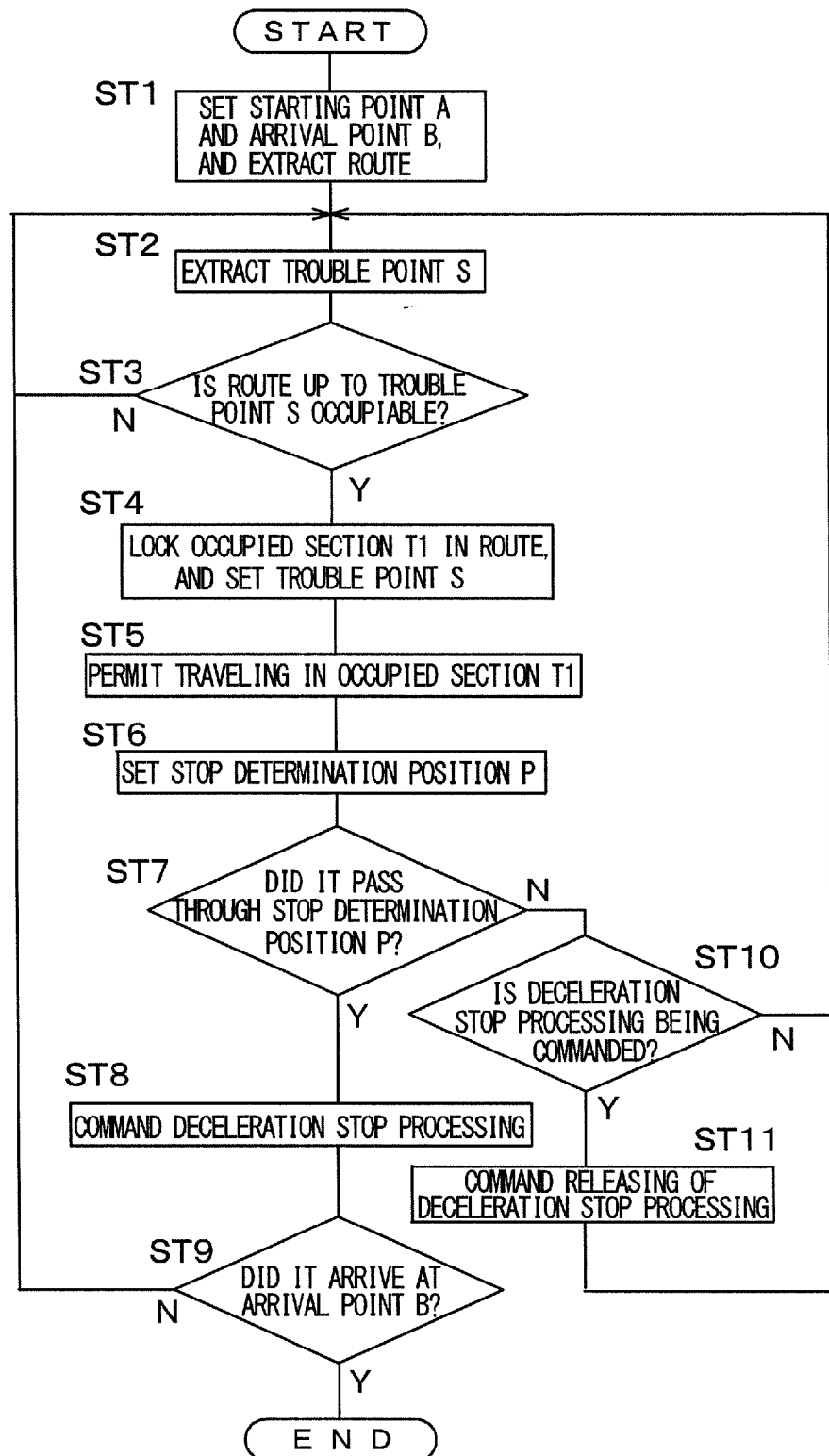


FIG. 4

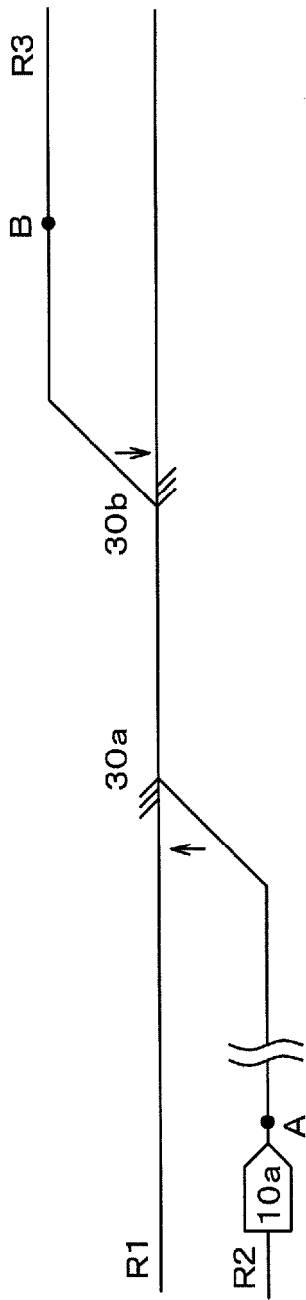


FIG. 5

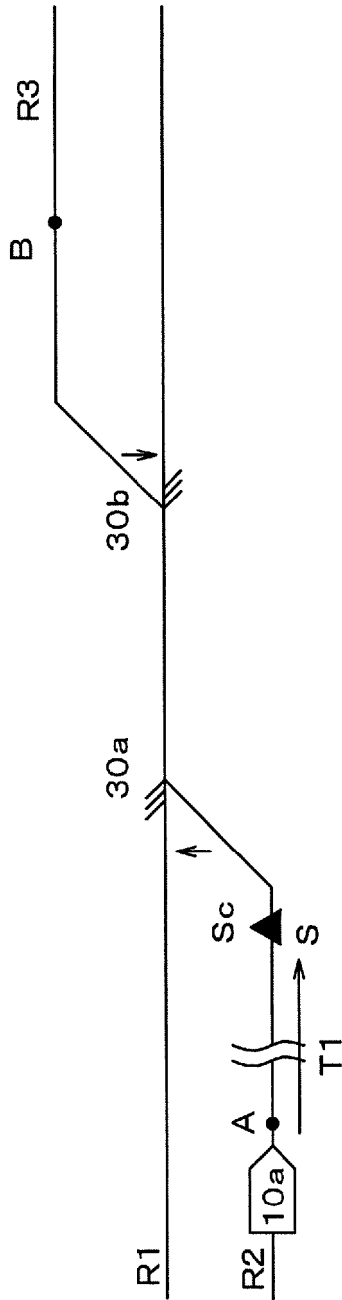


FIG. 6

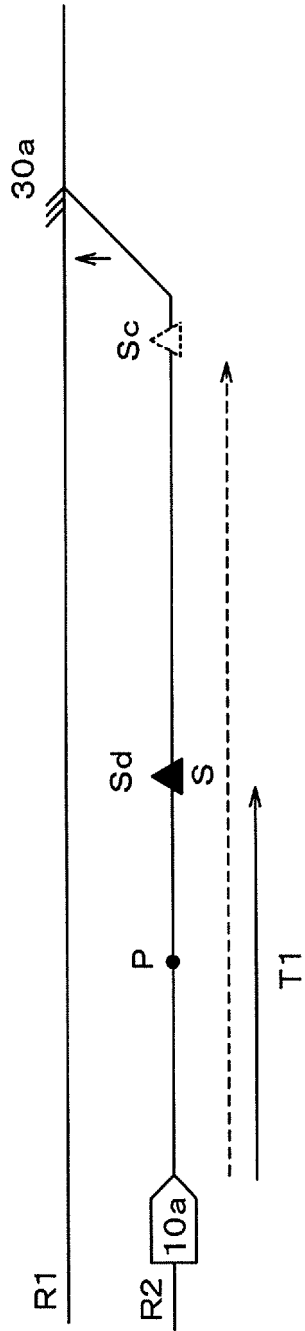


FIG. 7

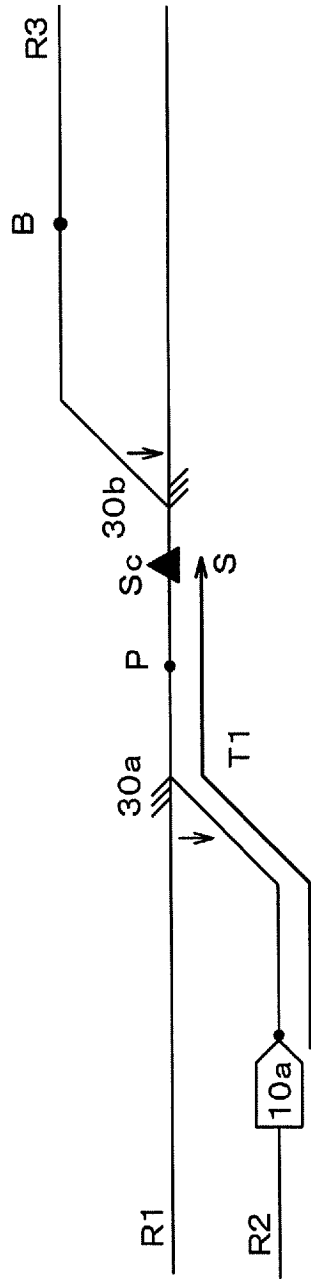


FIG. 8

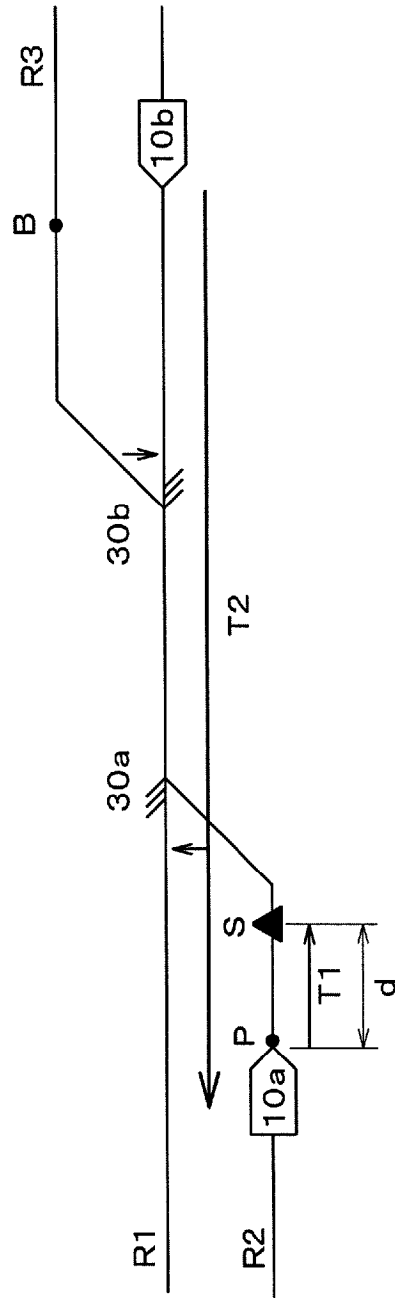


FIG. 9

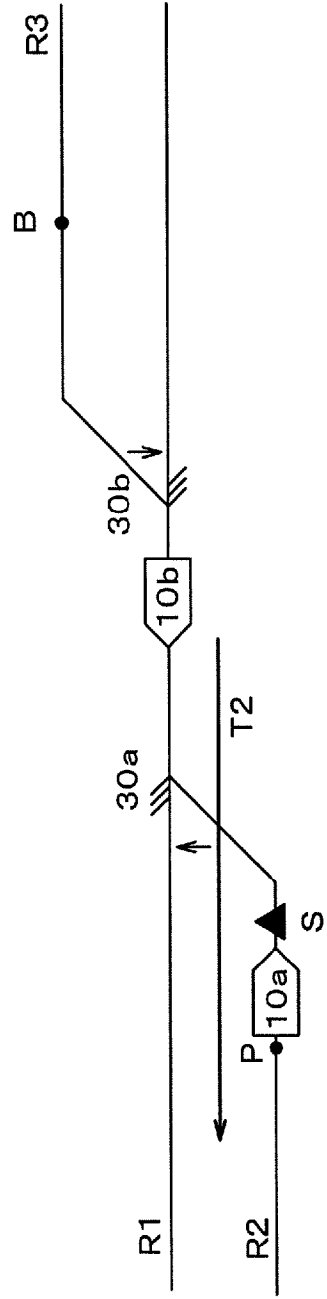


FIG. 10

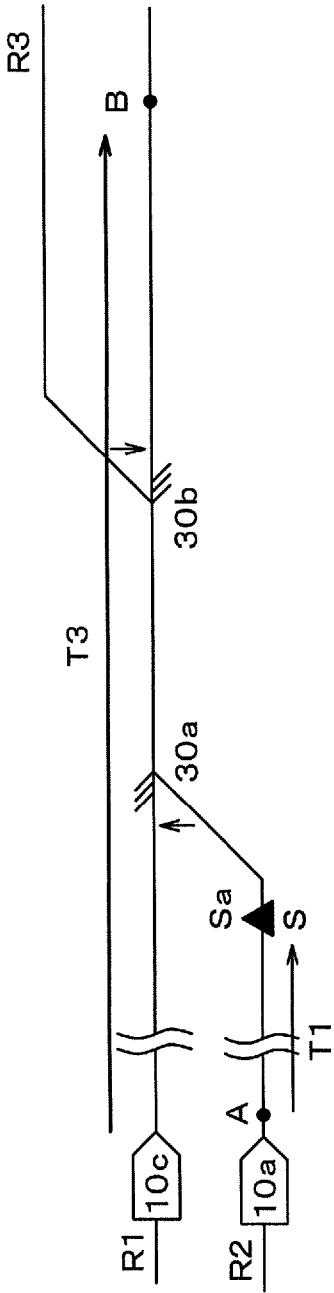


FIG. 11

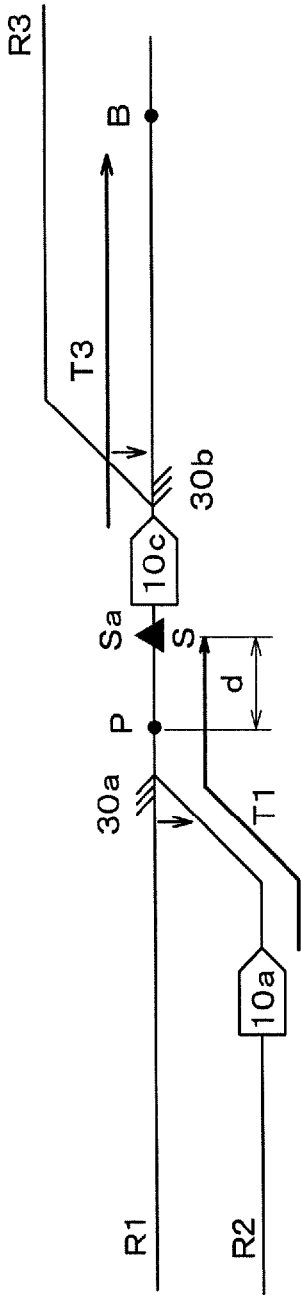


FIG. 12

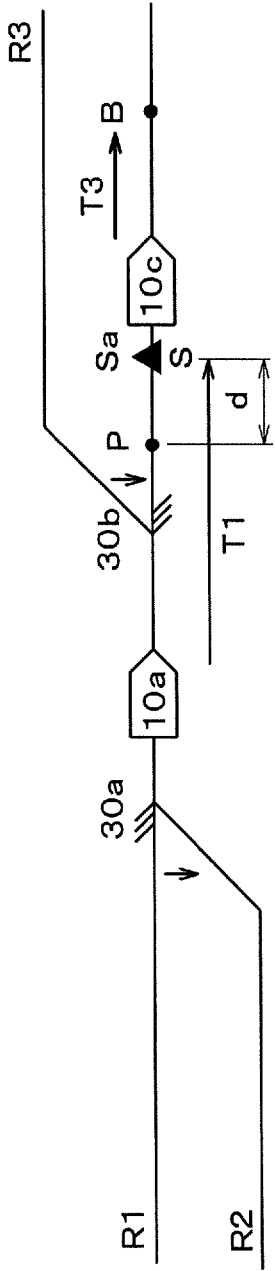
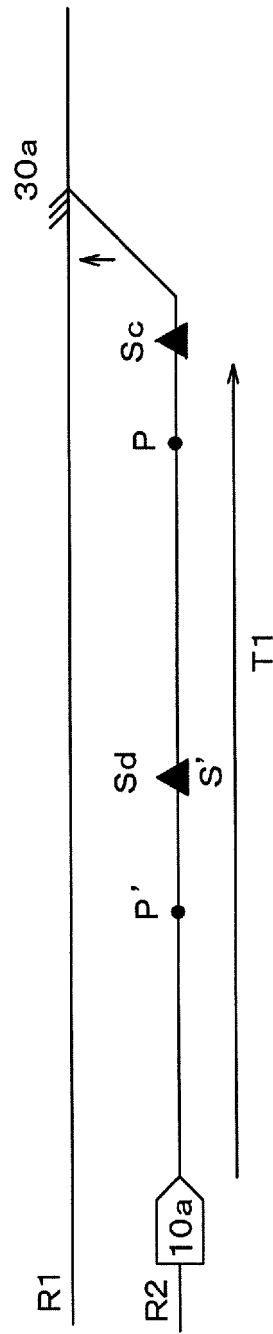


FIG. 13



REFERENCES CITED IN THE DESCRIPTION

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- JP 2000229574 A [0002] [0003] [0004] [0005]