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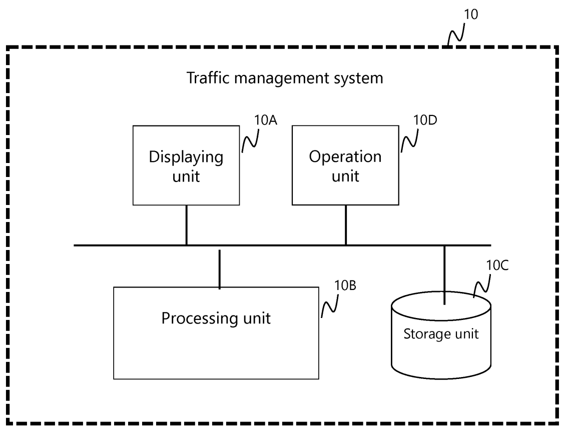
(54) OPERATION MANAGEMENT SYSTEM

(57) Provided is a technology that satisfactorily supports an operation of avoiding an obstacle by a dispatcher.

A traffic management system includes: a display unit for displaying a train graph screen that represents movement of a train over time as a diagram on a plane defined by an axis in a time direction and an axis in a route direction; and a processing unit for determining a timetable to service a train in a service mode of an obstacle avoidance operation type in an obstacle avoidance operation time slot and an obstacle avoidance operation area when the obstacle avoidance operation type, the obstacle avoidance operation time slot, and the obstacle avoidance operation area are specified, and displaying a train graph based on the timetable on the train graph screen, the obstacle avoidance operation type corresponding to a type of obstacle avoidance operation for servicing the train by avoiding an obstacle, the obstacle avoidance operation time slot corresponding to a time slot in which the obstacle avoidance operation is applied on the train graph screen, the obstacle avoidance operation area corresponding to an area in which the obstacle avoidance operation is applied.

FIG. 2



EP 3 290 290 A1

Description

Technical Field

[0001] The present invention relates to a traffic management system for managing a train service on a railroad.

Background Art

[0002] In a train service on a railroad, an initial planned timetable may be disturbed when a traffic disturbance such as a technical problem or an accident occurs on a train in service. In such a case, a train dispatcher who manages the train service aims to recover from the traffic disturbance by replanning the timetable, manually controlling routes of trains, etc. using a traffic management system.

[0003] PTL 1 discloses a technology for providing a replanning system which can provide plentiful information for a dispatcher to make a decision of replanning strategy and good operability. PTL 1 states that "A process of displaying a traffic condition, a process of predicting a traffic condition, a process of checking a prediction result, a process of displaying the result, and a process of suggesting a restoration plan are provided. When a traffic condition is displayed, it is possible to select a display mode in which a planned timetable, an actual timetable, and a predicted timetable are overlapped and displayed or separately displayed according to a request of the dispatcher. When a traffic condition is predicted, the dispatcher may select a prediction strategy suitable for a situation from among a plurality of prediction strategies, a prediction check result is displayed as a hindrance mark or an automatic proposal mark, and the displayed hindrance mark or automatic proposal mark is picked using a mouse, thereby describing content of the mark or proposing a restoration plan." (See paragraph 0005).

Citation List

Patent Literature

[0004] PTL 1: JP 6-72333 A

Summary of Invention

Technical Problem

[0005] Various patterns are present as a pattern of a train service operation (hereinafter referred to as an "operation pattern"). Examples thereof include an running line change, platform blockage, etc. Further, examples of the running line change include a bi-directional running in which upward and downward trains run on the same track.

[0006] In an replanning operation in which a timetable is changed in response to notification of the traffic disturbance, an operation pattern that avoids the occurring transport obstacle is implemented in some cases (hereinafter the operation pattern that avoids the transport obstacle will be referred to as an obstacle avoidance operation).

[0007] In the obstacle avoidance operation, the dispatcher is forced to perform a troublesome operation such as changing or setting each train service which may have a complicated influence.

[0008] However, PTL 1 does not describe any specific function for supporting an obstacle restoration operation by the dispatcher. For example, PTL 1 does not describe what type of information is provided to the dispatcher for the obstacle restoration operation.

[0009] An object of the invention is to provide a technical solution that satisfactorily supports an operation of avoiding an obstacle by the dispatcher.

Solution to Problem

[0010] A traffic management system according to an aspect of the present invention includes: a display unit for displaying a train graph screen which represents movement of a train over time as a diagram on a plane defined by an axis in a time direction and an axis in a route direction; and a processing unit for determining restoration plan in which trains run in a designated obstacle avoidance operation pattern for an obstacle avoidance operation time slot and an obstacle avoidance operation area which are specified on a train graph screen; a processing unit for displaying a train graph which corresponds to the determined restoration plan.

[0011] A traffic management system according to another aspect of the present invention includes : a display unit for displaying an track diagram screen that indicates positions of trains at a current time on a track; and a processing unit for setting a subsequent station ahead of an obstacle occurrence position corresponding to a position at which an obstacle occurs and up to a station to which a train heading for the obstacle occurrence position is allowed be turned back in a reverse direction by tracing a route from the obstacle occurrence position as warning target stations when the obstacle occurs on the track, and displaying the warning target stations on the track diagram screen.

[0012] A traffic management system according to still another aspect of the present invention includes: a storage unit for storing platform allocation management information that associates a virtual platform ID corresponding to information determining a direction and a role of each platform with a physical platform ID; and a processing unit for determining restoration plan such that the physical platform associated with the virtual platform is used in the direction and for the role of the virtual platform.

Advantageous Effects of Invention

[0013] According to the invention, it is possible to satisfactorily support a train service operation of avoiding an obstacle by a dispatcher. When the operation of avoiding an obstacle by the dispatcher is smoothly performed, it is possible to suppress an increase in traffic disturbance caused by an occurrence of an obstacle as much as possible, to improve punctuality of a train service, and to suppress loss such as a decrease in profit due to the traffic disturbance.

Brief Description of Drawings

[0014]

[FIG. 1] FIG. 1 is a schematic block diagram of a traffic management system according to the present embodiment.
[FIG. 2] FIG. 2 is a block diagram illustrating a functional configuration of the traffic management system.
[FIG. 3] FIG. 3 is a table illustrating an example of a timetable in the present embodiment.
[FIG. 4] FIG. 4 is a table illustrating an example of obstacle information in the present embodiment.
[FIG. 5A] FIG. 5A is a diagram illustrating a display example of an track diagram screen at the time of occurrence of an obstacle.
[FIG. 5B] FIG. 5B is a diagram illustrating a display example of an influence range due to the obstacle on a train graph screen.
[FIG. 5C] FIG. 5C is a flowchart illustrating a process of specifying a range in which an influence of the obstacle is received.
[FIG. 5D] FIG. 5D is a flowchart illustrating a process of specifying a warning range in which an influence of the obstacle may be propagated.
[FIG. 5E] FIG. 5E is a diagram illustrating an example of the train graph screen when the obstacle occurs.
[FIG. 5F] FIG. 5F is a diagram illustrating an example of the train graph screen when a sub-event is added as the obstacle information.
[FIG. 6A] FIG. 6A is a diagram illustrating a display example of the train graph screen when a dispatcher specifies a area and a time slot in which a bi-directional operation is performed.
[FIG. 6B] FIG. 6B is a diagram illustrating a state of correction of an obstacle avoidance operation time slot and an obstacle avoidance operation area.
[FIG. 6C] FIG. 6C is a table for description of an example of a method of correcting the obstacle avoidance operation time slot and the obstacle avoidance operation area.
[FIG. 7A] FIG. 7A is a diagram illustrating a display of a train graph screen that shows a train service plan in which the bi-directional operation is performed in an obstacle avoidance operation area and an obstacle avoidance operation time slot specified by the dispatcher.
[FIG. 7B] FIG. 7B is a diagram illustrating a display of a train graph screen that shows a train service plan in which an obstacle avoidance operation time slot is corrected.
[FIG. 7C] FIG. 7C is a diagram for description of a method of determining a train service plan in which the bi-directional operation is applied.
[FIG. 7D] FIG. 7D is a flowchart illustrating a process of determining a time at which an obstacle avoidance operation is ended.
[FIG. 8A] FIG. 8A is a diagram illustrating an example of a screen display when the dispatcher inputs an restoration from the obstacle.
[FIG. 8B] FIG. 8B is a diagram illustrating a display example of a screen inquiring of the supervisor whether to end the obstacle avoidance operation from a train graph screen 13.
[FIG. 9A] FIG. 9A is a diagram illustrating a train service plan as a train graph at the time of returning from the bi-directional operation to a normal operation.
[FIG. 9B] FIG. 9B is a diagram for description of another train service plan at the time of returning from the bi-directional operation to the normal operation.
[FIG. 9C] FIG. 9C is a diagram for description of another train service plan at the time of returning from the bi-directional operation to the normal operation.
[FIG. 10A] FIG. 10A is a diagram illustrating a display example of the track diagram screen when a technical problem occurred on a certain train at a certain station.
[FIG. 10B] FIG. 10B is a diagram illustrating a table for managing allocation of a platform.
[FIG. 10C] FIG. 10C is a diagram illustrating an example of timetable information using a virtual platform and a physical platform.
[FIG. 11] FIG. 11 is a diagram illustrating a state in which an running line of a downward passing train is specified by dragging a mouse on a track diagram screen 12.
[FIG. 12] FIG. 12 is a diagram illustrating an example in which various information exchanged on a system in relation to the occurrence of the traffic disturbance is displayed in time series by text.
[FIG. 13A] FIG. 13A is a diagram illustrating an example of a screen display that defines time, a sender, and classification of information as filtering conditions.
[FIG. 13B] FIG. 13B is a diagram illustrating an example of a screen display in which classification of information is allowed to be selected by a button operation in filtering.

Description of Embodiments

[0015] A schematic description will be given of an embodiment of a traffic management system according to the invention.

[0016] FIG. 1 is a schematic block diagram of a traffic management system according to the present embodiment. A traffic management system 10 includes a human machine interface (HMI) 11, a timetable management device 14, a route control device 15, an obstacle information management device 16, a replanning device 17, and a network 18. The traffic management system 10 is connected to field equipment 30 through an field equipment management system 20. The field equipment management system 20 is a system disposed on a site side, and monitors or controls the field equipment 30 in cooperation with the traffic management system 10. The field equipment 30 corresponds to various facilities such as a switch, a traffic light, a track circuit, etc. used for a train service at a site.

[0017] The HMI 11 is an interface for displaying to a dispatcher and receiving an operation of the dispatcher. The HMI 11 displays a traffic condition in real time, receives a change in a timetable, and transmits a received change request to a related device. The HMI 11 is a terminal device having two display devices as an example, and displays two screens corresponding to an track diagram screen 12 and a train graph screen on the respective display devices. The track diagram screen 12 displays a current train position using a track diagram. The train graph screen 13 displays a predicted timetable and an actual timetable in which each train service plan and actuals are displayed as a path representing movement of a train over time.

[0018] The timetable management device 14 holds data of a timetable created in advance in an accompanying storage unit 14a. When a change in the timetable is requested during the operation, the timetable management device 14 receives a timetable change plan based on the request from the replanning device 17, and updates the data of the timetable held by the storage unit 14a based on received data. The timetable management device 14 provides data of the timetable to another device as necessary. In addition, the timetable management device 14 receives information about a travel record of the train from the field equipment 30 and stores the received information.

[0019] The route control device 15 records information related to route control such as field equipment status information, train position information, etc. in an accompanying storage unit 15a. The route control device 15 instructs the field equipment managing system 20 to control a set or cancel the route of the train based on the timetable received from the timetable management device 14. The field equipment management system 20 receiving this instruction controls the field equipment 30 such as the traffic light, the switch, etc. to realize the indicated setting or canceling of the route.

[0020] The obstacle information management device 16 records information related to management of the obstacle such as obstacle information, track linkage, etc. in an accompanying storage unit 16a. The obstacle information management device 16 manages obstacle information corresponding to information about an obstacle related to the train service. Examples of the obstacle information include obstacle information automatically given from the field equipment management system 20 and obstacle information given by transmission and reception of information between related devices related to management of the train service.

[0021] The replanning device 17 stores information such as rules for timetable planning in an accompanying storage unit 17a. When the change of the train service plan is necessary, the replanning device 17 creates a modified timetable based on an operation from the HMI 11. The replanning device 17 transmits the modified timetable to the timetable management device 14 to update the timetable of the timetable management device 14.

[0022] In addition, the replanning device 17 may predict a future traffic condition based on a current traffic condition.

[0023] In addition, the replanning device 17 may transmit the modified timetable to the timetable management device 14 to display the modified timetable on the HMI 11 before updating data used for the route control, thereby urging the dispatcher to visibly check the new timetable in advance.

[0024] Here, an example in which the timetable management device 14, the route control device 15, the obstacle information management device 16, and the replanning device 17 are physically separately implemented is shown. However, the invention is not limited to this example. It suffices to functionally implement the devices, and a physical configuration is not particularly limited. As another example, all the devices may be implemented on one computer or implemented by being dispersed on a plurality of computers.

[0025] FIG. 2 is a block diagram illustrating a functional configuration of the traffic management system. The traffic management system 10 includes a display unit 10A, a processing unit 10B, a storage unit 10C, and an operation unit 10D. The display unit 10A and the operation unit 10D correspond to the HMI 11 of FIG. 1, the processing unit 10B corresponds to the timetable management device 14, the route control device 15, the obstacle information management device 16, and the replanning device 17 of FIG. 1, and the storage unit 10C corresponds to the storage units 14a, 15a, 16a, and 17a.

[0026] The display unit 10A displays a train graph screen that represents movement of the train over time as a diagram on a plane defined by an axis in a time direction and an axis in a route direction. When an obstacle avoidance operation type corresponding to a type of obstacle avoidance operation for servicing a train by avoiding an obstacle, an obstacle avoidance operation time slot corresponding to a time slot in which an obstacle avoidance operation is applied, and an obstacle avoidance operation area corresponding to an area in which the obstacle avoidance operation is applied are specified, the processing unit 10B determines a train service plan such that the train is serviced in the obstacle avoidance operation time slot and the obstacle avoidance operation area and in a service mode of the obstacle avoidance operation type, and displays a train paths based on the timetable on the train graph screen. In this way, when the dispatcher specifies the obstacle avoidance operation type, the obstacle avoidance operation time slot, and the obstacle avoidance operation area, the traffic management system automatically determines a timetable in which the obstacle avoidance operation of the service mode is applied in the time slot and the area, and thus it is possible to facilitate an operation of applying a predetermined service mode, and to support the dispatcher. For example, with regard to an obstacle avoidance operation type, the dispatcher only needs to input a type such as a bi-directional operation, and a complicated operation such as modifying individual train services to implement the bi-directional operation is unnecessary. It is possible to reduce situations in which a delay in response or an error in response occurs due to a complicated operation for recovery, and the train is stuck in a place outside a station to cause confinement in the train. In addition, since a complicated obstacle avoidance operation can be easily carried out, a possibility of continuing a train service increases even in a case in which an operation would have been interrupted in the past. A part of a timetable which predicts the future is referred to as a predicted timetable. Since a train timetable from the past to the present has a record of an actual train service, the traffic management system 10 is able to generate a prediction timetable.

[0027] In this instance, the processing unit 10B determines the timetable in the obstacle avoidance operation time slot and the obstacle avoidance operation area such that the timetable is consistent with a train service in a preceding time slot of the obstacle avoidance operation time slot, and determines a timetable in a subsequent time slot of the obstacle avoidance operation time slot such that the train service plan is consistent with the train service plan in the obstacle avoidance operation time slot. In this way, since the timetable is automatically determined such that the train service in the obstacle avoidance operation time slot is consistent with the preceding and subsequent time slots, the dispatcher may easily modify a timetable consistent with preceding and subsequent time slots only by indicating the obstacle avoidance operation time slot, the obstacle avoidance operation area, and the obstacle avoidance operation type.

[0028] For example, when it is presumed that the obstacle avoidance operation type corresponds to a bi-directional operation in which trains in two directions are allowed to travel on a single track by dividing a time, the processing unit 10B determines a bi-directional operation area corresponding to an area in which the bi-directional operation is performed defined by a first end station and a second end station at both ends based on the obstacle avoidance operation range, and determines a timetable such that when a train (first train) enters the bi-directional operation section from the first end station, another train (second train) arriving at the second end station is kept waiting, and the second train is allowed to enter the bi-directional operation section after the first train arrives at the second end station. In this way, the timetable in which trains in two directions are allowed to travel on the same track may be determined by the traffic management system 10. Thus, when an obstacle occurs, the dispatcher may set a bi-directional operation by an easy way to continue a service of trains for both directions.

[0029] In addition, when the obstacle avoidance operation time slot, the obstacle avoidance operation area, and the obstacle avoidance operation type are specified, the processing unit 10B corrects the obstacle avoidance operation range to an extended range in which the originally intended obstacle avoidance operation range is included and a train service of the obstacle avoidance operation type is applicable. Since the obstacle avoidance operation range and the obstacle avoidance operation type specified by the dispatcher are automatically corrected such that there is no inconsistency in a configuration of the facility, etc., the dispatcher may easily apply an appropriate obstacle avoidance operation.

[0030] In addition, when the bi-directional operation is performed as an obstacle avoidance operation type, the processing unit 10B corrects the specified obstacle avoidance operation area to an extended area including the obstacle avoidance operation area and having a station, in which a crossover is present between one track and another track, at each of both ends. In this way, since the obstacle avoidance operation area specified by the dispatcher is automatically corrected to an area in which the bi-directional operation is allowed, the dispatcher may easily make appropriate setting.

[0031] In this case, when there is a train traveling in an opposite direction to an original direction at a time when the obstacle avoidance operation time slot ends in the originally intended train service plan, the processing unit 10B performs correction to set a time until the train arrives at an end station of the obstacle avoidance operation range to the obstacle avoidance operation time slot. In this way, since the obstacle avoidance operation time slot specified by the dispatcher is automatically corrected to be consistent with the bi-directional operation, the dispatcher may easily set the obstacle avoidance operation time slot appropriate for the bi-directional operation.

[0032] In addition, according to another viewpoint, in the traffic management system 10 of the present embodiment, the display unit 10A displays the track diagram screen 12 that indicates an position of the train at a current time on the track. When an obstacle occurs on the track, the processing unit 10B sets a station in front of an obstacle occurrence position corresponding to a position at which the obstacle occurs and stations up to a station to which a train heading for the obstacle occurrence position can be turned back in a reverse direction by tracing the route from the obstacle occurrence position to warning target stations, and displays the warning target stations on the track diagram screen. In this way, since a station in a range in which a train may not be turned back when the train enters at the occurrence of an obstacle is displayed on the track diagram screen as a warning target station, the dispatcher may easily perform operation arrangement such that there is no train that may not be turned back at the occurrence of an obstacle. Normally, this warning target station is considered as a station at which progress of a train needs to be immediately stopped. When the dispatcher performs a train hold operation based on a display of the warning target station, it is possible to prevent situations such as a situation in which a train stops before a signal due to inappropriate hold setting, a situation in which a train stays in a section that does not allow the train to be turned back and thus even a partial service may not be resumed, etc.

[0033] In addition, the processing unit 10B sets a station which is a adjacent station of a warning target station to an attention target station, and displays the attention target station on the track diagram screen 12. In this way, a route in a reverse direction of an obstacle occurrence track at which even though operation of a train service may not be immediately stopped but should be monitored carefully because a train passes right beside an obstacle occurring place can be displayed as attention target stations. A station at which a train may not be able to depart since a preceding train is blocking the route can also be displayed as attention target stations. When such an attention target station is set, it is possible to prevent confusion that may occur in the future, and to shorten time required for recovery of a timetable. The above-described warning target station or attention target station may be displayed not only on the track diagram screen 12 but also on the train graph screen 13.

[0034] In addition, according to still another viewpoint, in the traffic management system 10 of the present embodiment, the storage unit 10C stores platform allocation management information that associates a virtual platform corresponding to information determining a direction and role for each platform with a physical platform. The processing unit 10B determines a timetable such that the physical platform associated with the virtual platform is used in the direction and for the role of the virtual platform. In this way, the supervisor may easily determine a timetable in which a platform is appropriately allocated by allocating a physical platform to a virtual platform for which a direction and role are determined. In addition, it is possible to collectively set platform used for all trains included in a timetable by setting a physical platform corresponding to a virtual platform. When time required for the dispatcher to input change data to the system is shortened, and another command task subsequent to platform setting change is rapidly carried out by such collective setting, it is possible to expect that recovery time from the traffic disturbance can be shortened.

[0035] In addition, the display unit 10A displays the platform allocation management information. The operation unit 10D allows individual setting of the platform allocation management information for each train by operation input. When a physical platform used by a certain train in a timetable is designated, the processing unit 10B determines the timetable by giving priority to the individually set physical platform over the virtual platform, and causes the display unit 10A to display the determined timetable. In this way, the dispatcher may individually set a physical platform used by each train of the timetable, and thus may easily and flexibly perform setting using collective setting by a virtual platform and individual setting by a physical platform.

[0036] In addition, when a physical platform is individually set with respect to a train in the timetable by the operation unit 10D, the processing unit 10B determines whether setting by a virtual platform is consistent with setting by a physical platform. In this way, even when the dispatcher inputs contradictory setting, the traffic management system 10 detects the contradictory setting, and thus it is possible to prevent a timetable including contradiction in platform setting from being generated. In this way, it is possible to construct a route in accordance with setting of the train service plan to realize a timetable.

[0037] In addition, the processing unit 10B causes the display unit 10A to display a configuration of a route including each platform of each station as a diagram, sets a platform for each train having a specified travel pattern based on an instruction on the operation unit 10D, and causes the display unit 10A to display the platform used by the specified train. In this way, the dispatcher may collectively set a platform used in each station for each travel pattern of a train, and it is be expected that recovery time from a traffic disturbance can be shortened by speeding up a command task.

[0038] Hereinafter, a more specific embodiment will be described in detail with reference to drawings.

Embodiment

[0039] A configuration of the traffic management system according to the present embodiment is the same as that illustrated in FIG. 1 and FIG. 2.

[0040] FIG. 3 is a table illustrating an example of a train service plan in the present embodiment. The train service plan of FIG. 3 corresponds to timetable information recording a time of arrival to a station, a time of departure from a station, a used platform at each station, and a traveling track (direction) for a train traveling on a certain route. A traveling track corresponding to a certain station indicates a track on which a train travels after departing from the station until the train arrives at a subsequent station. In a column of a used platform, a name of a virtually determined platform (virtual platform) is described. The virtual platform will be described below.

[0041] In the example of FIG. 3, a train departs from platform "Down1" of station A, departing the station at 7:15:00 to travel along a down track, passes through platform "Nonstop down" of station B at 7:26:30, passes through platform "Down1" of station C at 7:29:45, and arrives at platform "Up1" of station D at 7:34:00. Then, the train departs from station D at 7:34:45 to travel along an up track, passes through platform "Nonstop up" of station E at 7:40:00, and arrives at platform "Up2" of station F at 7:45:00. Further, the train departs from station F at 7:45:00 to arrive at platform "Down1" of station G at 7:50:15, departs at 7:51:00 to travel along a down track, and arrives at platform "Down1" of station H corresponding to a terminal station at 7:58:30.

[0042] FIG. 4 is a table illustrating an example of obstacle information in the present embodiment. For example, when an event of a certain obstacle occurs, the obstacle information management device 16 illustrated in FIG. 1 allocates an event ID to the obstacle, and records content, an occurrence place, and an occurrence time of the obstacle in the table present in the storage unit 16a. In addition, when another event occurs in response to the obstacle, the obstacle information management device 16 records the event as a sub-event in the table. The obstacle information management device 16 allocates a sub-event ID to the occurring sub-event, and records content and an occurrence time of the event in the table.

[0043] FIG. 4 illustrates an example in which a car of a train number 1A has technical problem, and the obstacle is described as an event of event ID = 5 in the table that records the obstacle information. The technical problem occurred at a spot 4.5 km away from station B on a down line, at 7:50. In response to the problem, a situation confirmation report are made at 8:00, first aid is being tried from 8:05, and recovery of the obstacle is estimated at 9:00.

[0044] FIG. 5A is a diagram illustrating a display example of the track diagram screen at the occurrence of an obstacle. FIG. 5A illustrates a display example of the track diagram screen 12 when train 1A traveling between station B and station C gets technical problem. Referring to FIG. 5A, a circular icon having x in content is displayed at an obstacle occurrence position of a track diagram. When information of the obstacle corresponding to the problem on train 1A is input, the obstacle information management device 16 automatically extracts an influence of the problem of train 1A and a area thereof, and displays the influence and the area on the track diagram screen 12.

[0045] Referring to FIG. 5A, on an upward line directed rightward in the figure, station A, station B, and station C correspond to warning target stations, which are indicated by broken line arrows. In addition, on the upward line, a preceding station of station A corresponds to an attention target station, which is indicated by a one-dot-chain line arrow. On a downward line, station B, station C, and station D correspond to attention target stations, which are indicated by one-dot-chain line arrows.

[0046] With regard to station B on the upward line, when a subsequent train of train 1A departs from station B, train 1A becomes an obstacle, and the following train becomes stuck. For this reason, a train directed from station B to station C should not depart. In addition, here, on the assumption that there is no facility for turning back at station B, when the following train of train 1A departs from station A, the following train is likely to be stuck in the same manner. For this reason, a train directed from station A to station B also should not depart. In this way, when an obstacle occurrence position and information of the track diagram are combined, it is possible to specify an area at which departure of a train should be held, and to hold a train in a state in which a partial service can be rapidly resumed. A detailed process will be described using FIG. 5C.

[0047] FIG. 5B is a diagram illustrating a display example of specific situations of the warning target station and the attention target station described above on the train graph screen. On the train graph screen, similarly to FIG. 5A, a circular icon having x in content is displayed at a point corresponding to a position and time at which an obstacle occurs . In addition, by displaying hatching of different patterns for a region 50 on the train graph screen corresponding to the area which corresponds to the broken line arrow in FIG. 5A and a region 51 on the train graph screen corresponding to the area which corresponds to the one-dot-chain line arrow in FIG. 5A, these regions are visualized on the train graph screen. In FIG. 5B, a range of a warning target and a range of an attention target are distinguished by hatching patterns. However, in addition to the above-described distinction, it is also possible to distinguish between up and down lines corresponding to a target by further increasing a hatching pattern.

[0048] FIG. 5C is a flowchart illustrating a process of specifying a range in which an influence of the obstacle is received. Referring to FIG. 5C, in response to occurrence of an obstacle, the obstacle information management device 16 extracts a station located one station ahead of an obstacle occurrence position and a station located one station behind the obstacle occurrence position in a progress direction of a train (step S101). Subsequently, the obstacle information management device 16 adds the extracted stations as warning target stations (step S102).

[0049] Subsequently, the obstacle information management device 16 performs warning target station addition loop processing of steps S103 and S104.

[0050] In the warning target station addition loop processing, the obstacle information management device 16 determines whether a last added backward station can turn back a train (step S103) . When the last added station is a station that can turn back a following train, the obstacle information management device 16 ends the process as it is. On the other hand, the last added station is a station that cannot turn back a train, the obstacle information management device 16 adds a backward station of the last added station as a warning target station (step S104), and returns to step S103. In this way, the obstacle information management device 16 extracts all the warning target station.

[0051] In addition, in FIG. 5A, the train directed from station C to station B passes right beside the obstacle occurrence position, and thus there is a possibility that some influence such as a temporary speed limit may be applied. In this way, a range that may receive a secondary influence is set to an attention target region even though the range is not a direct influence range in which departure of a train should be immediately held.

[0052] FIG. 5D is a flowchart illustrating a process of specifying an attention target range. The process of specifying the attention target range is repeatedly performed for each warning target station.

[0053] First, the obstacle information management device 16 selects a warning target station to be processed (step S201) . Subsequently, the obstacle information management device 16 adds a backward station of the selected warning target station in an upward direction as attention target station (step S202) . Further, the obstacle information management device 16 adds a backward station of the selected warning target station in a downward direction as an attention target station (step S203) .

[0054] FIG. 5E is a diagram illustrating an example of the train graph screen when an obstacle occurs.

[0055] When an obstacle occurs, and information about the obstacle is input, the obstacle information management device 16 displays the obstacle information on the train graph screen 13. The train graph screen 13 at a time at which the obstacle occurs is illustrated in FIG. 5E.

[0056] It can be understood that train 1A located between station B and station C at a current time has a technical problem. When a predetermined operation is performed on an icon indicating the obstacle, the obstacle information management device 16 displays specific information about the obstacle and an action to be taken on the obstacle. Examples of the predetermined operation include click, mouse-over, etc. For example, display of the specific information about the obstacle and the action to be taken on the obstacle corresponds to pop-up display, etc. In the example of FIG. 5A, an obstacle occurrence time and an obstacle occurrence position are displayed as a specific obstacle, and a call with a person concerned, editing event information, and an obstacle avoidance operation are displayed as the alternatives to be taken. The specific obstacle and the action to be taken on the obstacle may be similarly displayed when a predetermined operation is performed on an icon on the track diagram screen.

[0057] FIG. 5F is a diagram illustrating an example of the train graph screen when a sub-event is added as the obstacle information. A straight line horizontally extending from an icon indicating an obstacle indicates an influence of occurrence of the obstacle, a thick part in the middle indicates a time at which first aid action starts with respect to the obstacle, and a right end portion indicates an estimated time of recovery. In this way, it is possible to visualize an extent of influence due to occurrence of the obstacle. In the example of FIG. 5F, when a predetermined operation is performed on a recovery estimation part, an obstacle occurrence time and a recovery estimated time are displayed. In this way, when event information or sub-event information are visualized and displayed on the train graph screen, it is possible to easily detect a relation between an occurring event and a train service, and the dispatcher may rapidly and easily determine a necessary change of the timetable. If the timetable is quickly modified, an operation interruption time at the occurrence of a traffic disturbance is shortened, and it is possible to continue a service of each train according to the modified timetable.

[0058] Next, a description will be given of a series of processes in a case in which when an obstacle occurs, the dispatcher performs a bi-directional operation, in which a single track is alternately used by trains in two directions, in an influence receiving range in a time slot in which the obstacle have an influence.

[0059] Here, a case of performing a bi-directional operation, in which trains in two directions alternately pass on one side track not involved with trouble, between station B and station C from the state illustrated in FIG. 5A is given as an example of replanning.

[0060] FIG. 6A is a diagram illustrating a display example of the train graph screen when the dispatcher first specifies an area and a time slot in which a bi-directional operation is needed.

[0061] It is presumed that the dispatcher specifies a range in which the bi-directional operation is needed to include an icon indicating an obstacle and a line extending rightward from the icon and indicating an influence of the obstacle on the train graph screen 13. For example, it is possible to specify a rectangular region on the train graph screen 13. In this case, the rectangular region corresponds to the bi-directional operation range. In FIG. 6A, the specified rectangular region is indicated by hatching. For example, this selection operation may be performed by dragging of a mouse, etc.

[0062] This operation is an operation of specifying an obstacle avoidance operation time slot and an obstacle avoidance operation area, and a hatching part indicates the specified range. When the obstacle avoidance operation time slot and the obstacle avoidance operation area are specified, the replanning device 17 corrects the obstacle avoidance operation time slot and the obstacle avoidance operation area as necessary, generates a modified timetable for applying an obstacle avoidance operation of a specified obstacle avoidance operation type to the region, and transmits the modified timetable to the timetable management device 14. Here, the obstacle avoidance operation type corresponds to the bi-directional operation. Hereinafter, a description will be given on the assumption that a process related to modification of the timetable is performed by the replanning device 17. However, actual functional arrangement is not limited thereto, and another device in the traffic management system 10 may perform the process.

[0063] FIG. 6B is a diagram illustrating a state of correction of the obstacle avoidance operation time slot and the obstacle avoidance operation area. Since a crossover between upward and downward tracks is not present between station B and station C as illustrated in FIG. 5A, station B and station C may not be used as end stations of the bi-directional operation. Station A and station D have crossovers, and thus may be used as end stations of the bi-directional operation.

[0064] Therefore, as illustrated in FIG. 6B, the replanning device 17 automatically corrects the range in which the bi-directional operation (as a type of obstacle avoidance operation) is applied (the obstacle avoidance operation time slot and the obstacle avoidance operation area) to a range using station A and station D as end stations at both sides. When such correction is determined on the system side, the dispatcher may immediately start to input the bi-directional operation without considering a track configuration of each station, and may realize shortening of time required to change the timetable, that is, resumption of the train service in a short time.

[0065] FIG. 6C is a diagram for description of an example of a method of correcting the obstacle avoidance operation time slot and the obstacle avoidance operation area. The replanning device 17 holds a table illustrated in FIG. 6C in advance.

[0066] The table of FIG. 6C indicates whether each station can be used as an end station of a bi-directional operation (using either upward track or downward track). For example, stations A, D, and E can be used as a starting station or a terminal station of bi-directional operation both for using upward track and downward track, since a crossover connecting the upward track and the downward track exists in each of the stations A, D, and E. On the other hand, stations B and C can be used as neither a starting station nor a terminal station of bi-directional operation, both for using the upward track and the downward track.

[0067] In a case in which a train has a technical problem between station B and station C, and a bi-directional operation is performed, in response to a region having station B and station C as both end stations being specified, the replanning device 17 specifies a range including station B and station C and having stations corresponding to end stations of the bi-directional operation at both ends with reference to the table of FIG. 6C, and corrects the obstacle avoidance operation area to the range.

[0068] Next, a description will be given for a method of creating a new train service and a method of setting a time at which a bi-directional operation is ended. In this instance, creation of the new train service, that is, adding and changing of train paths on a train graph are automatically performed by the replanning device 17.

[0069] FIG. 7A is a diagram illustrating a display of a train graph screen that shows a timetable in which the bi-directional operation is performed in an obstacle avoidance operation area and an obstacle avoidance operation time slot specified by the dispatcher. In the timetable, the bi-directional operation is performed until a designated end time specified by the dispatcher, and thereafter the operation returns to a normal operation.

[0070] However, this modification to the timetable is incomplete. Train 3B is on a different track from a track on which the train is assumed to be between station A and station D on the original plan, that is, train 3B is on the same track as that of train 4E. Thus, in practice, train 3B cannot pass by train 4E between station C and station D. For this reason, train 4E may not depart from station D until train 3B arrives at station D.

[0071] When a bi-directional operation is applied to a timetable, the replanning device 17 automatically corrects an end time, and determines a timetable applicable to an actual train service. A description will be given below.

[0072] FIG. 7B is a diagram illustrating a display of a train graph screen that shows a timetable in which an obstacle avoidance operation time slot is corrected.

[0073] FIG. 7C is a diagram for description of a method of determining a train path when the bi-directional operation is applied.

[0074] Here, an area in which the bi-directional operation is applied is between station P and station Q. That is, an obstacle avoidance operation range is between station P and station Q.

[0075] With regard to train 2B initially entering between station P and station Q corresponding to the area in which the bi-directional operation is applied, the replanning device 17 obtains a time of arrival to station P using a standard operating time t1 of this section. Subsequently, the replanning device 17 lets train 3C depart from station P after waiting for a predetermined time (intersection hindrance time) t2 from the time of arrival to station P of train 2B considering intersection of routes with train 2B at station P. Thereafter, similarly, the replanning device 17 lets train 4C depart from station Q after a time obtained by adding a traveling time t3 of train 3C between station P and station Q and an intersection hindrance time t4 of train 3C and train 4C from a time at which train 3C departs from station P. In addition, the replanning device 17 lets train 5E depart from station P after a total time of a traveling time t5 of train 4C between station P and station Q and an intersection hindrance time t6 of train 4C and train 5E from a time at which train 4C departs from station Q. When such a process is performed, it is possible to create a timetable having consistency in a specific operation pattern corresponding to the bi-directional operation. Therefore, the route control device can issue a control command to the field equipment management system as the same manner as usual, even when the complicated bi-directional operation is performed.

[0076] Next, a description will be given for a process of determining a time at which the obstacle avoidance operation is ended.

[0077] FIG. 7D is a flowchart illustrating a process of determining a time at which the obstacle avoidance operation is ended. First, the replanning device 17 sets a designated end time input by the dispatcher as a scheduled end time of the obstacle avoidance operation (step S301).

[0078] Subsequently, the replanning device 17 performs processing of step S302 to step S305, and repeats processes from step S302 again when the scheduled end time has been updated at the time.

[0079] In step S302, the replanning device 17 extracts all trains traveling within the obstacle avoidance operation range at the scheduled end time of the obstacle avoidance operation (in this case, the bi-directional operation).

[0080] Further, the replanning device 17 repeats processing of step S303 and step S304 as many times as the number of extracted trains. In step S303, the replanning device 17 determines whether a train subjected to processing in a current loop is running on a different track from a track on which the train is assumed to travel on the original plan. When the train is running on the different track, the replanning device 17 sets a time at which the train arrives at a terminal station of a corresponding section as the scheduled end time (step S304).

[0081] In step S305, the replanning device 17 determines whether the scheduled end time is updated in a current loop of step S302 to step S305. When the scheduled end time has been updated, the replanning device 17 returns to step S302 and repeats processing. When the scheduled end time has not been updated, the replanning device 17 ends a series of processes.

[0082] In the above-described example, a scheduled end time of an obstacle restoration operation is corrected from an end position of hatching of FIG. 7A to an end position of hatching of FIG. 7B by the above processing.

[0083] Next, a description will be given for an operation of the dispatcher and an operation of the traffic management system 10 at the time of recovering from an obstacle with reference to FIGS. 8A and 8B.

[0084] For example, in response to restoration from an obstacle occurring from a technical problem of a train, the dispatcher inputs restoration from the obstacle to the traffic management system 10 by editing event information. When the obstacle avoidance operation is applied for the obstacle, the obstacle information management device 16 associates the obstacle with the obstacle avoidance operation at the time of performing the obstacle avoidance operation. The obstacle information management device 16 determines whether the obstacle avoidance operation is associated with the obstacle to which the restoration is input. When the obstacle is associated with the obstacle avoidance operation, the obstacle information management device 16 prompts the dispatcher to verify whether to cancel the obstacle avoidance operation.

[0085] FIG. 8A is a diagram illustrating an example of a screen display when the dispatcher inputs the restoration from the obstacle. When the dispatcher inputs the restoration from the obstacle by applying a predetermined operation on an icon indicating obstacle information displayed on the train graph screen 13, the obstacle information management device 16 displays an image for prompting the dispatcher to select whether to cancel the bi-directional operation corresponding to the obstacle avoidance operation associated with the obstacle as a pop-up image as illustrated in FIG. 8B.

[0086] FIG. 8B is a diagram illustrating a display example of a screen inquiring of the dispatcher whether to end the obstacle avoidance operation from the train graph screen 13.

[0087] Here, it is presumed that the bi-directional operation is associated to the obstacle information. To prompt verification as to whether to end the bi-directional operation associated with the obstacle information on which a predetermined operation of inputting the restoration is performed, the obstacle information management device 16 instructs the HMI 11 to display the screen illustrated in FIG. 8B. When the dispatcher selects YES with respect to the display of FIG. 8B, the obstacle information management device 16 ends the event corresponding to the bi-directional operation, and instructs the replanning device 17 to modify a timetable for returning to the normal operation.

[0088] When a certain event is performed in relation to the obstacle as described above, the obstacle information management device 16 may record information about the performed event by associating the information with the obstacle information. For example, an event performed in relation to the obstacle information illustrated in FIG. 4 may be additionally described in the obstacle information. Further, for example, when an icon indicating the event of the obstacle is selected, and the end of the event is input, the obstacle information management device 16 extracts an obstacle avoidance operation associated with the obstacle with reference to a table of the obstacle information, and displays a screen prompting verification as to whether the obstacle avoidance operation can be ended.

[0089] Here, an example of inquiring about canceling the obstacle avoidance operation when recovery from the obstacle is input is described. However, it is possible to inquire about canceling the obstacle avoidance operation at another time.

[0090] For example, it is possible to inquire about canceling the obstacle avoidance operation when an estimated end time of the obstacle avoidance operation is reached, and the obstacle has already been removed at that time. Alternatively, it is possible to inquire about canceling the obstacle avoidance operation when the obstacle has been removed before the estimated end time of the obstacle avoidance operation. In addition, it is possible to inquire about extending the obstacle avoidance operation when the obstacle remains at a point in time approaching the estimated end time of the obstacle avoidance operation. When the dispatcher does not respond to the inquiry and leaves the inquiry unsolved, the obstacle avoidance operation may be automatically extended in a predetermined n-minute unit, and the inquiry may be made again after the extension period. In addition, the extension period may be set to a period up to a time at which the obstacle avoidance operation can be ended on the given situation. In addition, when the obstacle avoidance operation may not be canceled in the entire obstacle avoidance region, it is possible to determine whether a new starting station or terminal station can be set based on a position at which the obstacle is left, and change the area when the station can be set. In this case, the estimated end time of the obstacle avoidance operation may be determined in the same manner as the above-described extension. In addition, in this case, when a train is left on a platform of a certain station by setting a new obstacle avoidance operation range, it is possible to issue a warning thereof. In addition, for example, when a train is on a physical platform that is no longer allocated to a virtual platform, a warning is issued. In this way, when event information and an obstacle avoidance operation with respect to the event information are combined and managed, for example, it is possible to prevent a problem that an operation of appropriately returning a pattern of a train operation is not performed after an event ends, and a train service is impeded.

[0091] Next, a description will be given of a process of ending the bi-directional operation and returning to the normal operation with reference to FIG. 9A to FIG. 9C.

[0092] FIG. 9A is a diagram illustrating a timetable at the time of returning from the bi-directional operation to the normal operation.

[0093] When an end of the bi-directional operation is input, the replanning device 17 generates a timetable change plan in which whether a train traveling in a reverse direction of an original track is present at that time is verified, and a train traveling in an opposite direction to that of the train is allowed to enter a section where the bi-directional operation has been performed as illustrated in FIG. 9A in response to the train arriving at a terminal station of the bi-directional operation if the train traveling in the reverse direction is present. On the other hand, when the train traveling in the reverse direction of the original track is not present, the replanning device 17 generates a timetable change plan that lets the train traveling in the opposite direction to that of the train immediately enter the section where the bi-directional operation has been performed.

[0094] FIG. 9B and FIG. 9C are diagrams for description of another train service plan at the time of returning from the bi-directional operation to the normal operation. In an example of FIG. 9A, since train 3B is traveling on a different track from a track on which train 3B is assumed to travel, train 4E may not depart from station D until train 3B arrives at station D, and a train directed from station D to station A may not travel for a long time.

[0095] Meanwhile, in another example, in this instance, a train traveling in the opposite direction may immediately enter a section where the bi-directional operation has been performed using the other track which was unavailable during the occurrence of an obstacle.

[0096] Recovery from the obstacle allows the other unavailable track to be used. Therefore, in the other example, the replanning device 17 changes the timetable to allow train 4E to use this track, that is, to allow both train 3B and train 4E to use the track in the reverse direction of the originally used track.

[0097] As illustrated in FIG. 9B, the replanning device 17 displays a menu screen that can command a change of the timetable. Here, a change example of individually specifying train 4E to let only train 4E travel on a reverse line will be described. In practice, as still another example, it is possible to change the train service plan to let all trains directed from station D to station A reverse-line travel. In this case, an area and a time slot may be specified similarly to the example of FIG. 6A.

[0098] FIG. 9C is a diagram illustrating a timetable in a case of letting both train 3B and train 4E travel on a reverse line. Letting train 4E also travel on the reverse line accelerates recovery of all train timetables. FIG. 9C illustrates a case in which train 5C is also instructed to travel on the reverse line.

[0099] Next, a description will be given of an example of bypassing a place where an obstacle occurs by changing allocation of a platform with reference to FIGS. 10A to 10C.

[0100] FIG. 10A is a diagram illustrating a display example of the track diagram screen when a technical problem occurs on a certain train at a certain station. FIG. 10A illustrates an example in which train 3B gets technical problem on platform 1 of station Y. Here, allocation of a platform may be changed by applying a predetermined operation to an icon indicating the obstacle.

[0101] FIG. 10B is a diagram illustrating a table for managing allocation of a platform. A platform is managed by two types of platform information, each corresponds to a "virtual platform" and a "physical platform". The virtual platform indicates a role such as a platform used as the first platform of a downward train. The physical platform indicates a physical platform that identifies a position where a train actually arrives or passes. As illustrated in FIG. 10B, the replanning device 17 may generate a timetable change plan in which a specific physical platform is not used by changing a combination of the virtual platform and the physical platform.

[0102] Further, in particular, when the replanning device 17 patterns a typical allocation change in advance and holds pattern information in advance, the dispatcher may change platform allocation by a simple operation. For example, it is determined in advance that physical platform 2 is used as the first platform for downward trains when physical platform 1 is unavailable, and pattern information of the change is held in advance. Then, when the platform becomes unavailable as in a case in which a train on physical platform 1 get technical problem, the dispatcher may easily change allocation by fetching and applying the held pattern information. In this way, when an obstacle corresponding to a pattern occurs, it is possible to immediately change allocation of a platform, and continue a train service.

[0103] In addition, the replanning device 17 may hold a combination that cannot be allocated in advance. When the dispatcher tries to allocate a platform, the replanning device 17 determines whether the input setting can be accepted with reference to the information about the combination that cannot be allocated. In this way, it is possible to prevent inappropriate platform allocation from being performed.

[0104] FIG. 10C is a diagram illustrating an example of a timetable using a virtual platform and a physical platform. The timetable management device 14 basically uses a virtual platform as a platform defined in a timetable. Further, as illustrated in FIG. 10B, it is possible to collectively change platform allocation of all trains that use a corresponding station by changing a physical platform allocated to a virtual platform.

[0105] Further, as indicated in No. 8 and No. 9 of FIG. 10C, a physical platform may be designated for an individual train in the timetable. When a physical platform is set in the timetable, the timetable management device 14 gives priority to allocation of an individual train over collective allocation in a unit of a station illustrated in FIG. 10B. In this way, it is possible to change platform allocation of an individual train. In this case, the replanning device 17 may verify whether allocation of an individual train is consistent with collective allocation for each station, and call the attention of the dispatcher when the allocations are not consistent with each other. In this way, when allocation of an individual train is inconsistent with allocation for each station, or when there is a contradiction therebetween, it is possible to alert the dispatcher by displaying a warning icon on the train graph screen. For example, when setting of a physical platform is inconsistent with setting of a virtual platform, or when setting for a station is inconsistent with setting for a train, it is possible to consider displaying a warning icon that calls the attention of the dispatcher. In this way, it is possible to prevent the timetable from being modified inappropriately, in which a route cannot be set and a train service is disturbed.

[0106] Next, a description will be given for inputting a change of a running line of a train. The above-described bi-directional operation may be regarded as an example of this running line change. FIG. 11 illustrates a station in which a running line of a downward passing train is specified by dragging a mouse on a track diagram of the track screen 12.

[0107] For example, when an upward train and a downward train are set on the same track, the replanning device 17 determines that the bi-directional operation is applied to the part, and generates such a timetable change plan. When an running line is specified herein with regard to a pattern of each service mode, it is possible to flexibly perform various running line changes such as a double-track co-directional operation, an upward/downward line switch operation, etc. in addition to the bi-directional operation.

[0108] In addition, on the contrary, with regard to a pattern of a typical service mode such as the bi-directional operation or the upward/downward line switch operation, a station and a platform to which an upward train and a downward train are allocated may be specified in advance, and the replanning device 17 may hold setting information thereof in advance. In this way, when the dispatcher selects a service mode desired to be applied, it is possible to easily perform the obstacle avoidance operation illustrated in FIG. 7A to FIG. 7D or FIG. 9A to FIG. 9C. In this way, when a traffic disturbance corresponding to a pattern occurs, it is possible to immediately change the timetable, and to minimize a time at which an operation of a train is interrupted.

[0109] FIG. 12 is a diagram illustrating an example in which various information exchanged on a system in relation to the occurrence of the obstacle is displayed in time series by text.

[0110] The traffic management system 10 defines a sentence format including a variable part such as a train ID, a station name, etc. in advance, and determines information to be described in the variable part based on an operation input of the dispatcher, etc. or a result of calculation performed by the system with respect to the input.

[0111] A description of "Dispatcher ○○" indicates that "input obstacle occurrence information" of 7:53 displayed in an uppermost part of FIG. 12 corresponds to information generated based on an operation performed by the dispatcher. The traffic management system 10 determines a train in which an obstacle occurs, a position at which the obstacle occurs, and a time at which the obstacle occurs based on the input of the dispatcher, and generates text data in the uppermost part of FIG. 12 by describing the determined train, position, and time in the variable part.

[0112] In addition, a description of "automatic calculation by system" indicates that "specify obstacle influence range" of 7:53 displayed in a second uppermost part of FIG. 12 corresponds to information generated based on automatic calculation by the traffic management system 10. The traffic management system 10 describes a train restraint range (warning target station) and an attention calling range (attention target station) obtained by automatic calculation in a variable part to generate text data in the second uppermost part of FIG. 12.

[0113] In addition, a description of "train 1A crew" indicates that "obstacle cause identified" of 8:01 displayed in a fourth uppermost part of FIG. 12 corresponds to information which is a cause determined by a crew of train 1A and input from a terminal. When the crew inputs information such as the cause of the obstacle, information as to whether the train having the obstacle can move, etc. from the terminal, the traffic management system 10 describes the information in a variable part to generate text data in the fourth uppermost part of FIG. 12.

[0114] The traffic management system 10 distributes completed text data to terminals used by other dispatchers, a station staff of each station, a crew of a related train, etc. In this way, a time-series status corresponding to a type of occurring obstacle and a type of response to the obstacle may be shared among a plurality of people concerned.

[0115] In this instance, creation and distribution of the text data are automatically performed by the traffic management system 10, and thus the dispatcher do not have to perform specific operation input for transmitting information. Information is automatically distributed to another person concerned only when the dispatcher performs an operation for responding to the above-described obstacle. For this reason, more information may be shared without an increase in the number of operations to be performed by the dispatcher. In this way, the dispatcher may rapidly and appropriately determine a countermeasure against an occurring event, and minimize disturbance in a train service.

[0116] Here, an example of distributing data in a text format is described. However, the invention may not be limited thereto. As another example, the traffic management system 10 may generate data of a chart, an image, etc., and distribute the generated data.

[0117] Next, a description will be given of a function of filtering information accumulated in a time series. The traffic management system 10 has a function of accumulating various types of information in a time series, and filtering the information according to various conditions. For example, it is possible to perform filtering to extract only information about occurrence of an obstacle, extract only information indicating delay, or extract only information related to a change of a timetable.

[0118] The traffic management system 10 assigns tag information to each information item at the time of generating, accumulating, and distributing each information item. At the time of browsing the information, the traffic management system 10 and a terminal receiving the distributed information may extract and display only information according to a predetermined condition by filtering using the tag information.

[0119] FIG. 13A is a diagram illustrating an example of a screen display that defines time, a sender, and classification of information as filtering conditions. FIG. 13B is a diagram illustrating an example of a screen display in which classification of information is allowed to be selected by a button operation in filtering. By allowing a condition to be input by a simple input method, for example, a station staff may promptly browse necessary information at the time of extracting and browsing only information according to a predetermined condition using a small portable terminal. In FIG. 13B, a condition is displayed by a character string on a button. However, the invention may not be limited thereto. As another example, when an appropriate figure, etc. that allows a condition to be easily detected is displayed on a button, it is possible to more intuitively perform a filtering operation.

[0120] The above-described embodiment and examples are examples for description of the invention, and are not intended to limit the scope of the invention to only the embodiment and examples. Those skilled in the art may implement the invention in various other modes without departing from the subject matter of the invention.

[0121] For example, even though the bi-directional operation is given as an example of the obstacle avoidance operation in the present embodiment and example, the invention is not limited thereto. As another example, it is possible to adopt an upward/downward line reversal operation in which an upward train is allowed to travel on a downward track and a downward train is allowed to travel on an upward track, the double-track co-directional operation in which trains in the same direction, for example, upward trains are distributed and allowed to travel on a plurality of tracks, etc.

[0122] In addition, even though a technical problem of a train traveling between stations is given as an example of an obstacle in the present embodiment and example, the invention is not limited thereto. As another example, it is possible to consider a state in which a specific platform becomes unavailable due to a technical problems on a switch, on a stopped train, on a station facility such as an elevator of the platform, etc. Information about such obstacle may be displayed on the track diagram screen 12 and the train graph screen 13.

Reference Signs List

[0123]

10	traffic management system
10A	display unit
10B	processing unit
10C	storage unit
10D	operation unit
12	track diagram screen
13	train graph screen
14	timetable management device
14a	storage unit
15	route control device
15a	storage unit
16	obstacle information management device
16a	storage unit
17	replanning device
17a	storage unit
18	network
20	field equipment management system
30	field equipment

Claims

1. A traffic management system, comprising:

a display unit for displaying a train graph screen that represents movement of a train over time as a diagram on a plane defined by an axis in a time direction and an axis in a route direction;

and
a processing unit for determining a timetable to service a train in a service mode of an obstacle avoidance operation type in an obstacle avoidance operation time slot and an obstacle avoidance operation area when the obstacle avoidance operation type, the obstacle avoidance operation time slot, and the obstacle avoidance operation area are specified, and displaying a train graph based on the timetable on the train graph screen, the obstacle avoidance operation type corresponding to a type of obstacle avoidance operation for servicing the train by avoiding an obstacle, the obstacle avoidance operation time slot corresponding to a time slot in which the obstacle avoidance operation is applied on the train graph screen, the obstacle avoidance operation area corresponding to an area in which the obstacle avoidance operation is applied.

2. The traffic management system according to claim 1, wherein the obstacle avoidance operation type corresponds to a bi-directional operation in which trains in two directions are allowed to travel on a single track at a different time, and
the processing unit
determines a bi-directional operation section corresponding to a section in which bi-directional operation is performed defined by a first end station and a second end station at both ends based on the obstacle avoidance operation range, and
determines the timetable such that when a first train enters the bi-directional operation section from the first end station, a second train arriving at the second end station is kept waiting, and the second train is allowed to enter the bi-directional operation section after the first train arrives at the second end station.

3. The traffic management system according to claim 1, wherein when the obstacle avoidance operation time slot, the obstacle avoidance operation area, and the obstacle avoidance operation type are specified, the processing unit corrects the obstacle avoidance operation range to a range in which the obstacle avoidance operation range is included and a train service of the obstacle avoidance operation type is applicable.

4. The traffic management system according to claim 3, wherein the obstacle avoidance operation type corresponds to a bi-directional operation in which trains in two directions are allowed to travel on a single track at a different time, and
the processing unit corrects the specified obstacle avoidance operation range to a range including the obstacle avoidance operation range and having a station, in which a crossover is present between the track and another track, at both ends.

5. The traffic management system according to claim 4, wherein when there is a train traveling in an opposite direction to an original direction at a time when the obstacle avoidance operation time slot ends in the designated timetable, the processing unit performs correction to set a time until the train arrives at an end station of the obstacle avoidance operation range to the obstacle avoidance operation time slot.

6. A traffic management system, comprising:

a display unit for displaying an track diagram screen that indicates an position of a train at a current time on a track; and
a processing unit for setting a subsequent station ahead of an obstacle occurrence position corresponding to a position at which an obstacle occurs and up to a station to which a train heading for the obstacle occurrence position is allowed be turned back in a reverse direction by tracing a route from the obstacle occurrence position as warning target stations when the obstacle occurs on the track, and displaying the warning target stations on the track diagram screen.

7. The traffic management system according to claim 6, wherein the processing unit sets a station which is a rear station of one of the warning target stations as an attention target station, and displays the attention target station on the track diagram screen.

8. A traffic management system, comprising:

a storage unit for storing platform allocation management information that associates a virtual platform corresponding to information determining a direction and role for each platform with a physical platform physically indicating each platform; and
a processing unit for determining a timetable such that the physical platform associated with the virtual platform is used in the direction and for the role of the virtual platform.

9. The traffic management system according to claim 8, further comprising:

a display unit for displaying the platform allocation management information; and
an operation unit for allowing setting of the platform allocation management information by operation input,
wherein when a physical platform used by a train set in the timetable is individually set, the processing unit determines the timetable by giving priority to the individually set physical platform over the virtual platform, and causes the

display unit to display the determined timetable.

10. The traffic management system according to claim 9, wherein when a physical platform is individually set with respect to a train set in the timetable by the operation unit,
the processing unit determines whether the setting by a virtual platform is consistent with the setting by a physical platform.

11. The traffic management system according to claim 10,
wherein the processing unit causes the display unit to display a configuration of a running line including each platform of each station as a diagram,
sets a platform passed by a specified train based on an operation on the operation unit, and
causes the display unit to display the platform of the line passed by the specified train.

FIG. 1

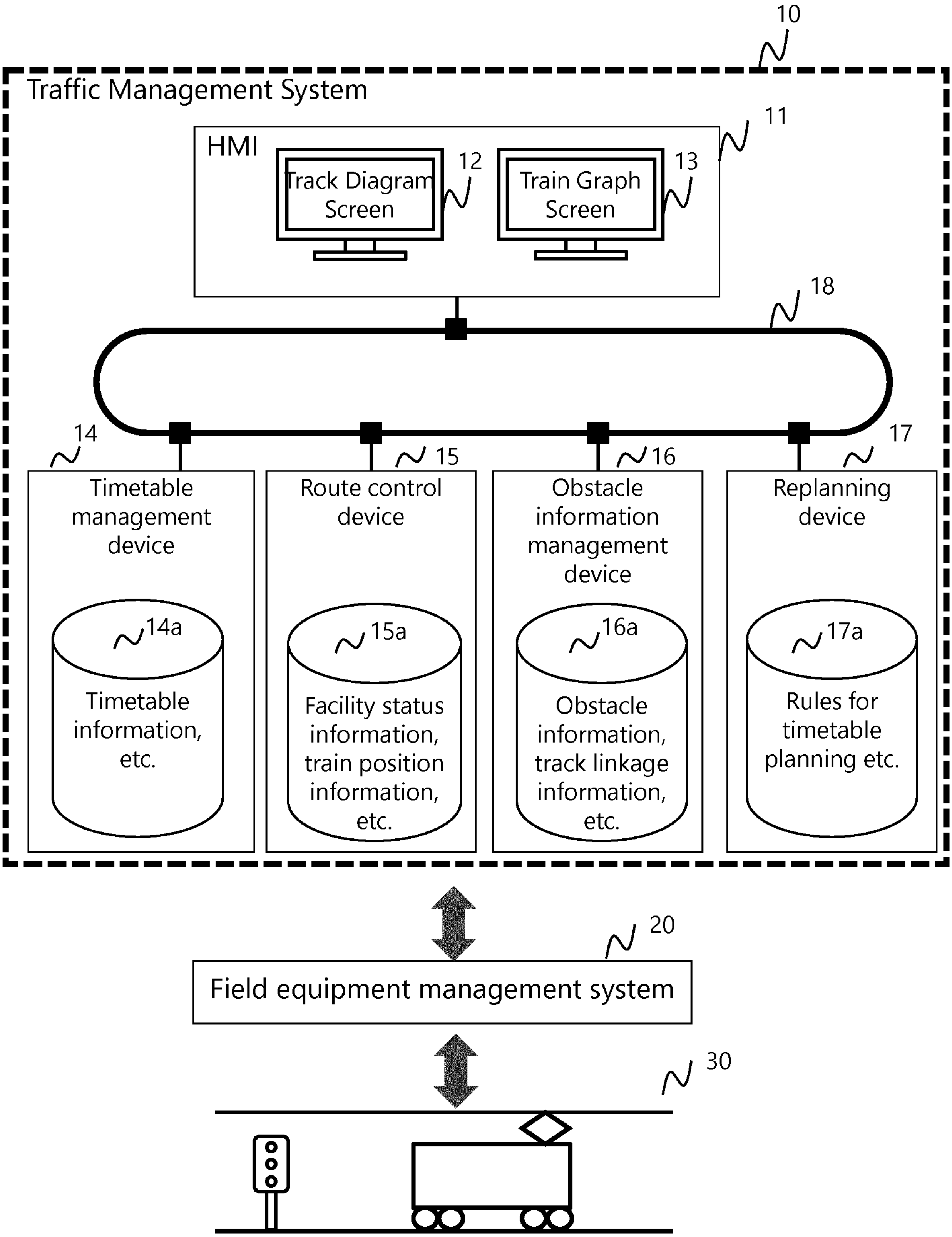

10
Traffic Management System
11
HMI
12
Track Diagram Screen
13
Train Graph Screen
18
14
Timetable management device
14a
Timetable information, etc.
15
Route control device
15a
Facility status information, train position information, etc.
16
Obstacle information management device
16a
Obstacle information, track linkage information, etc.
17
Replanning device
17a
Rules for timetable planning etc.
20
Field equipment management system
30

FIG. 2

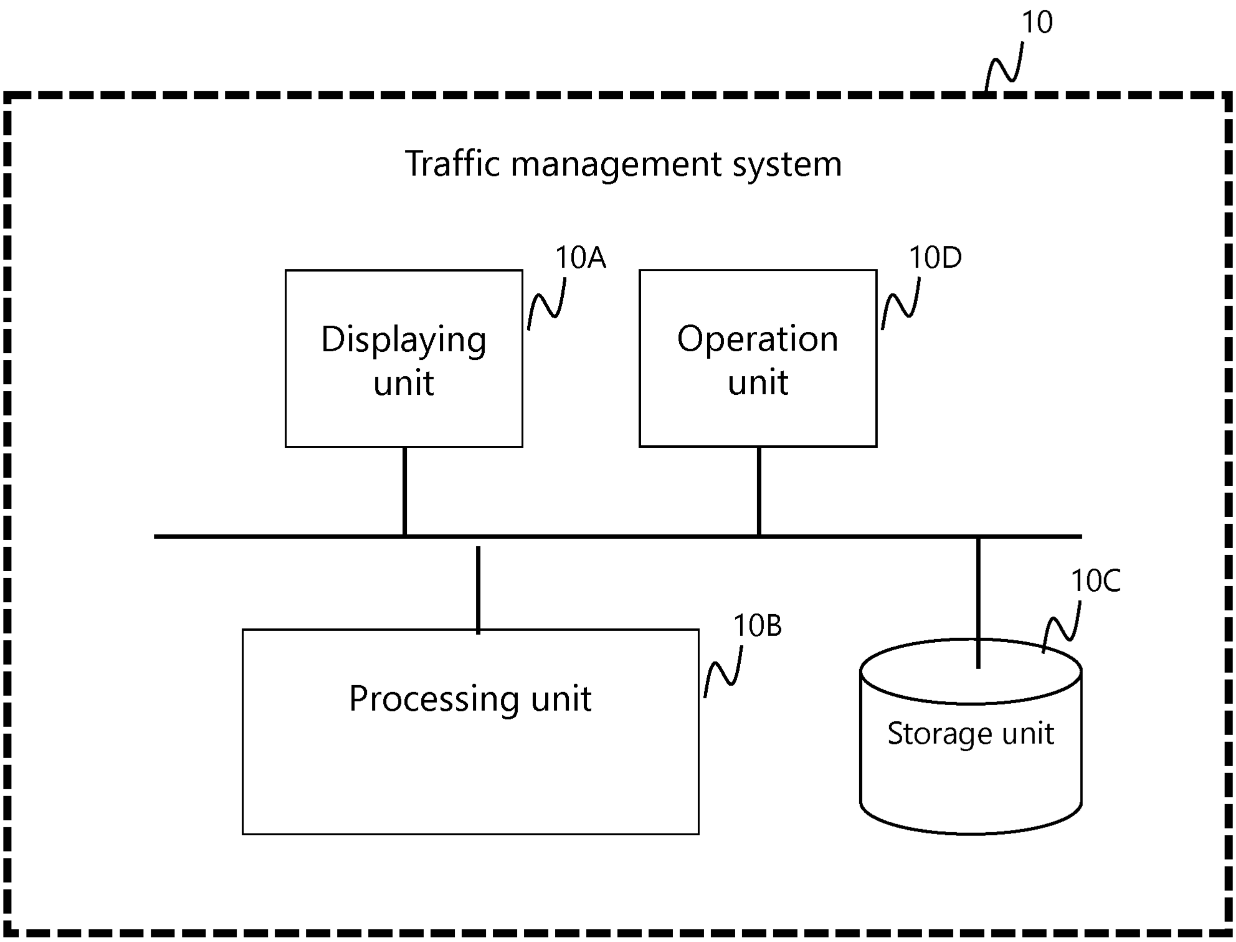

10
Traffic management system
10A
Displaying unit
10D
Operation unit
10C
10B
Processing unit
Storage unit

FIG. 3

No.	Station	Arrival time	Departure time	Platform	Running line
1	A	—	7:15:00	Down1	Down track
2	B	—	7:26:30	Nonstop down	Down track
3	C	—	7:29:45	Down1	Down track
4	D	7:34:00	7:34:45	Up1	Up track
5	E	—	7:40:00	Nonstop up	Up track
6	F	7:45:00	7:47:00	Up2	Down track
7	G	7:50:15	7:51:00	Down1	Down track
8	H	7:58:30	—	Down1	—

FIG. 4

Event ID	Content	Occurrence place	Time	Sub-event		
				ID	Content	Time
...	...	...	...	...	...	...
5	Technical problem (Train 1A)	4.5km from station B on down track	7:50	1	Situation confirmation report	8:00
				2	First aid	8:05
				3	Estimated recovery	9:00
...	...	...	...	...	...	...

FIG. 5A

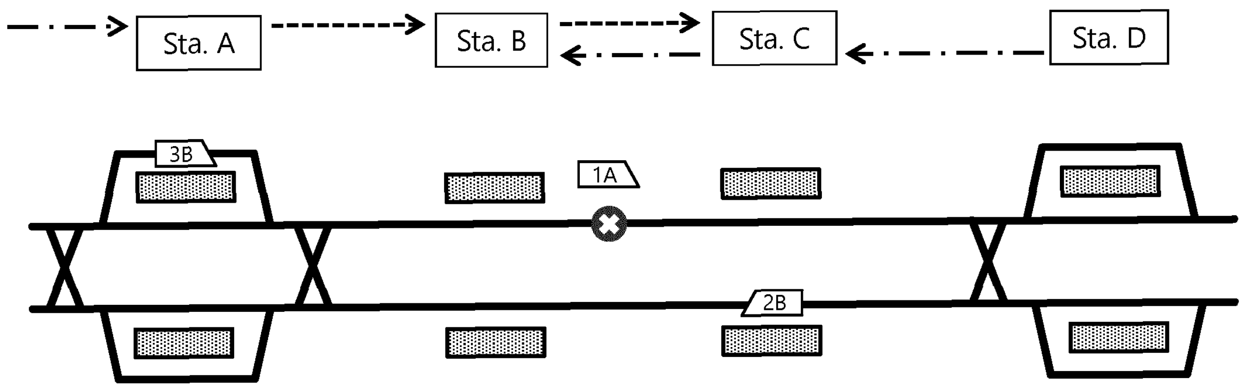


FIG. 5B

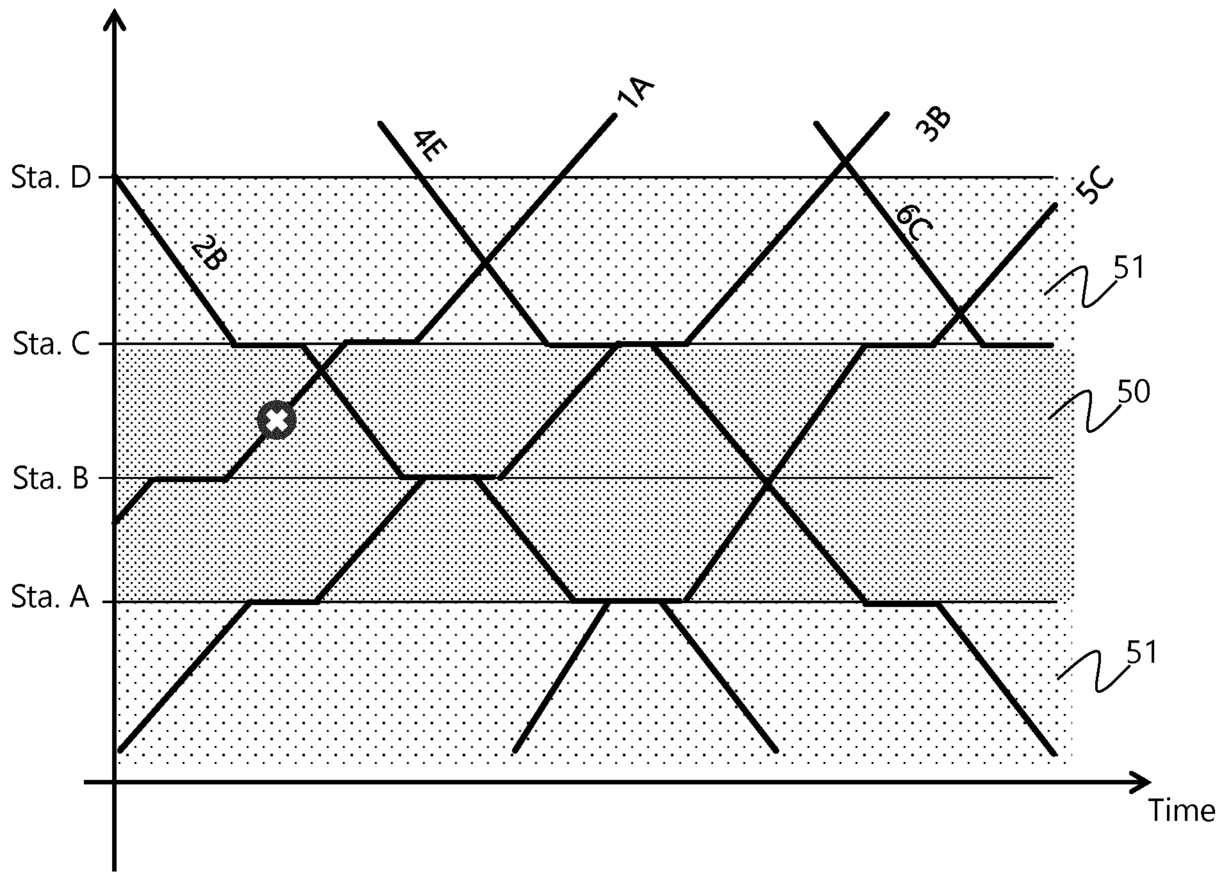


FIG. 5C

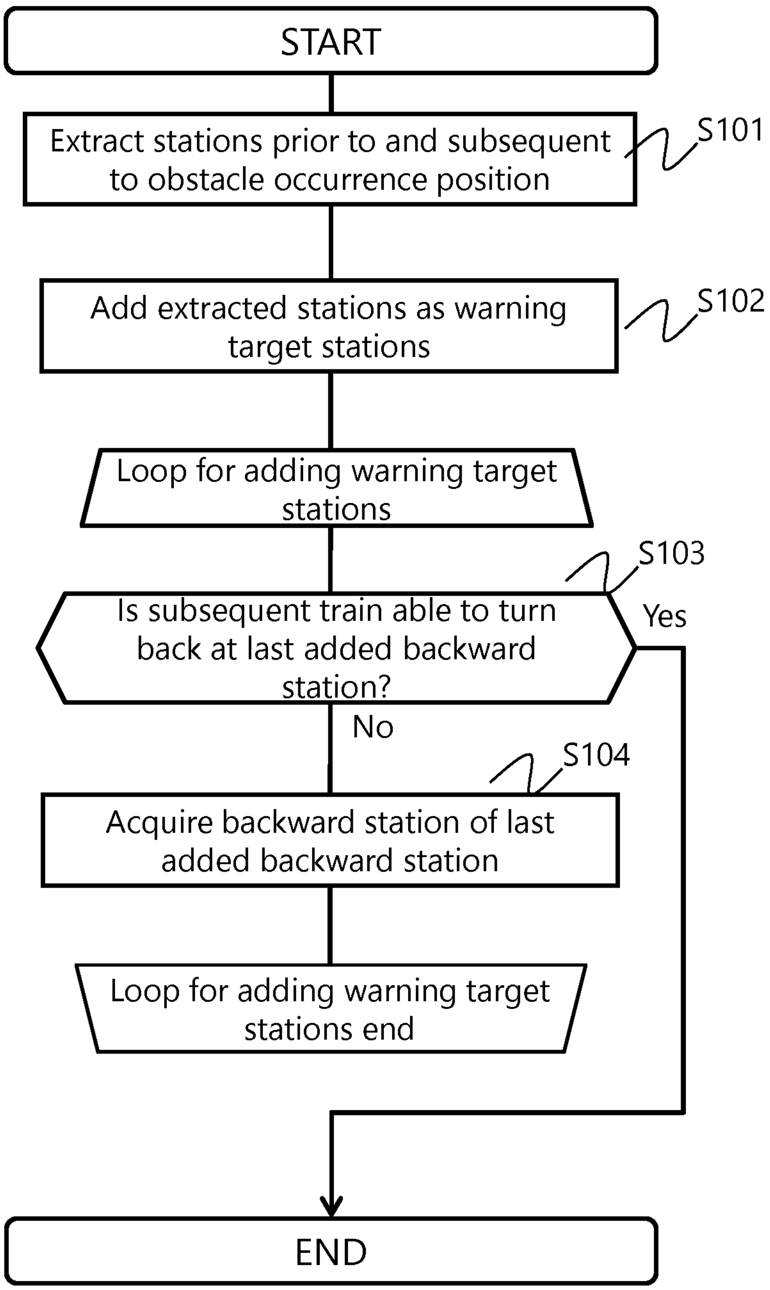

START
Extract stations prior to and subsequent to obstacle occurrence position
S101
Add extracted stations as warning target stations
S102
Loop for adding warning target stations
S103
Is subsequent train able to turn back at last added backward station?
Yes
No
S104
Acquire backward station of last added backward station
Loop for adding warning target stations end
END

FIG. 5D

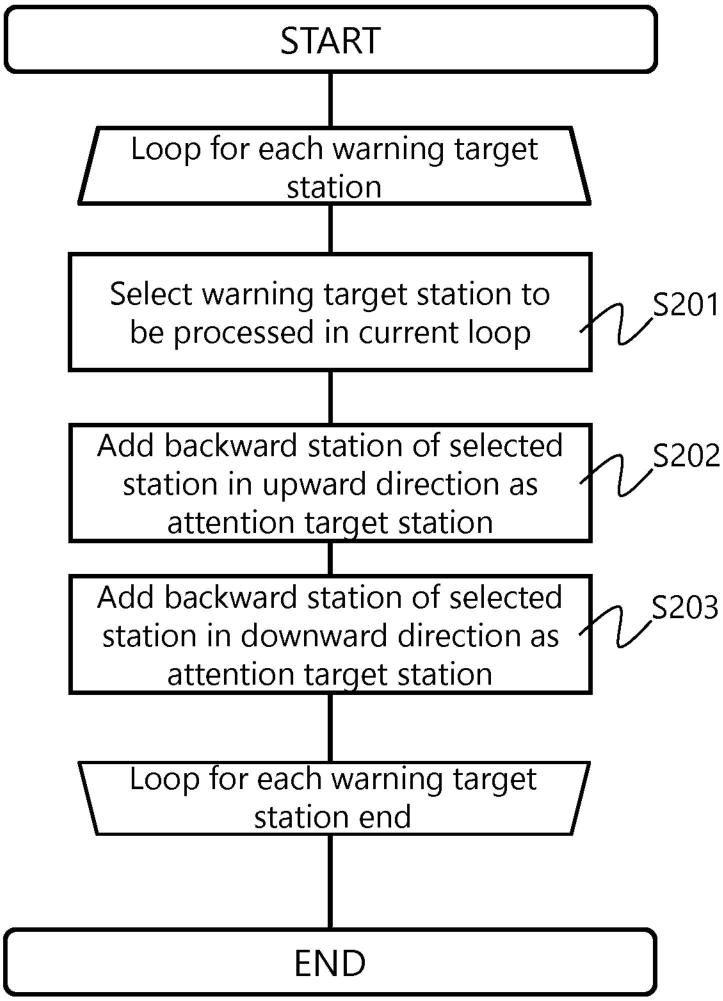

START
Loop for each warning target station
Select warning target station to be processed in current loop
S201
Add backward station of selected station in upward direction as attention target station
S202
Add backward station of selected station in downward direction as attention target station
S203
Loop for each warning target station end
END

FIG. 5E

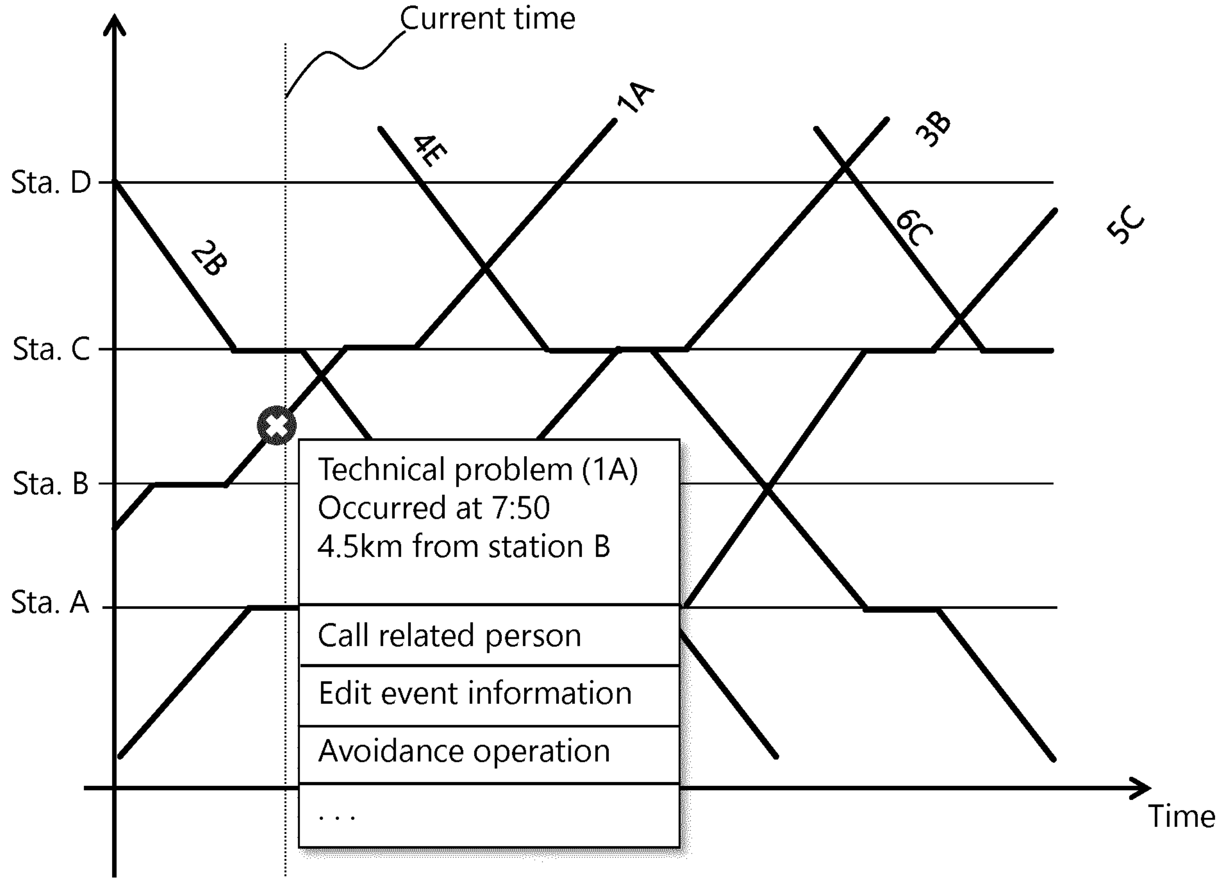
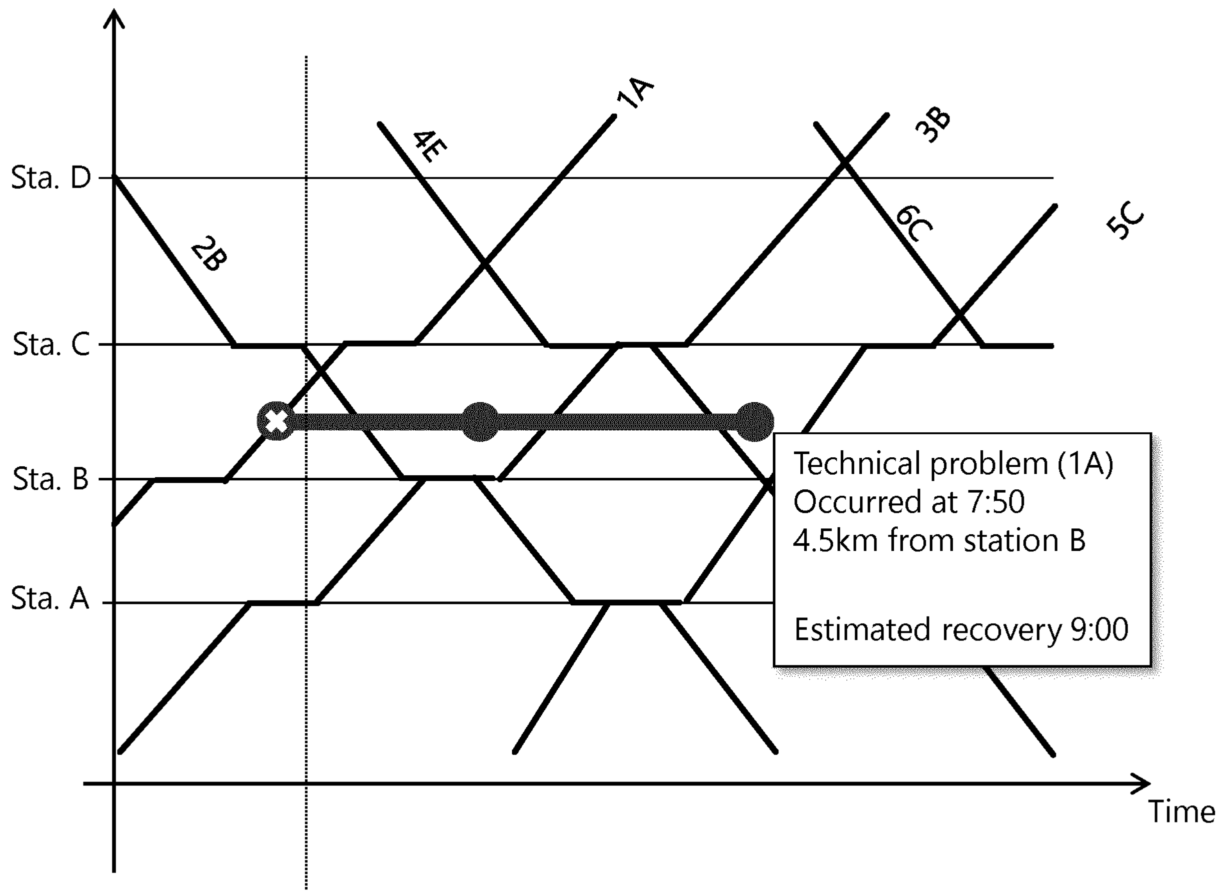

Current time
1A
4E
3B
2B
6C
5C
Sta. D
Sta. C
Sta. B
Sta. A
Technical problem (1A)
Occurred at 7:50
4.5km from station B
Call related person
Edit event information
Avoidance operation
. . .
Time

FIG. 5F



Sta. D
Sta. C
Sta. B
Sta. A
Time
2B
4E
1A
3B
6C
5C
Technical problem (1A)
Occurred at 7:50
4.5km from station B
Estimated recovery 9:00

FIG. 6A

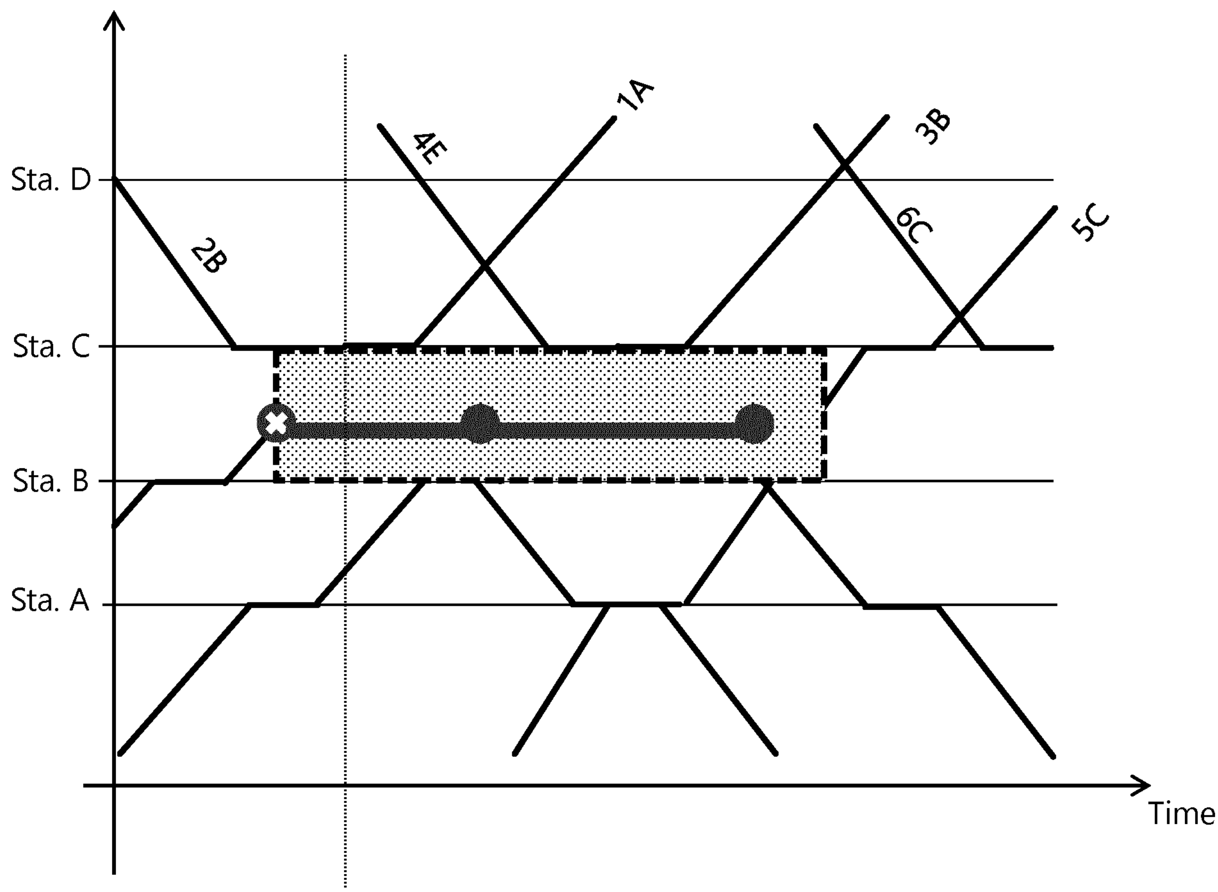


FIG. 6B

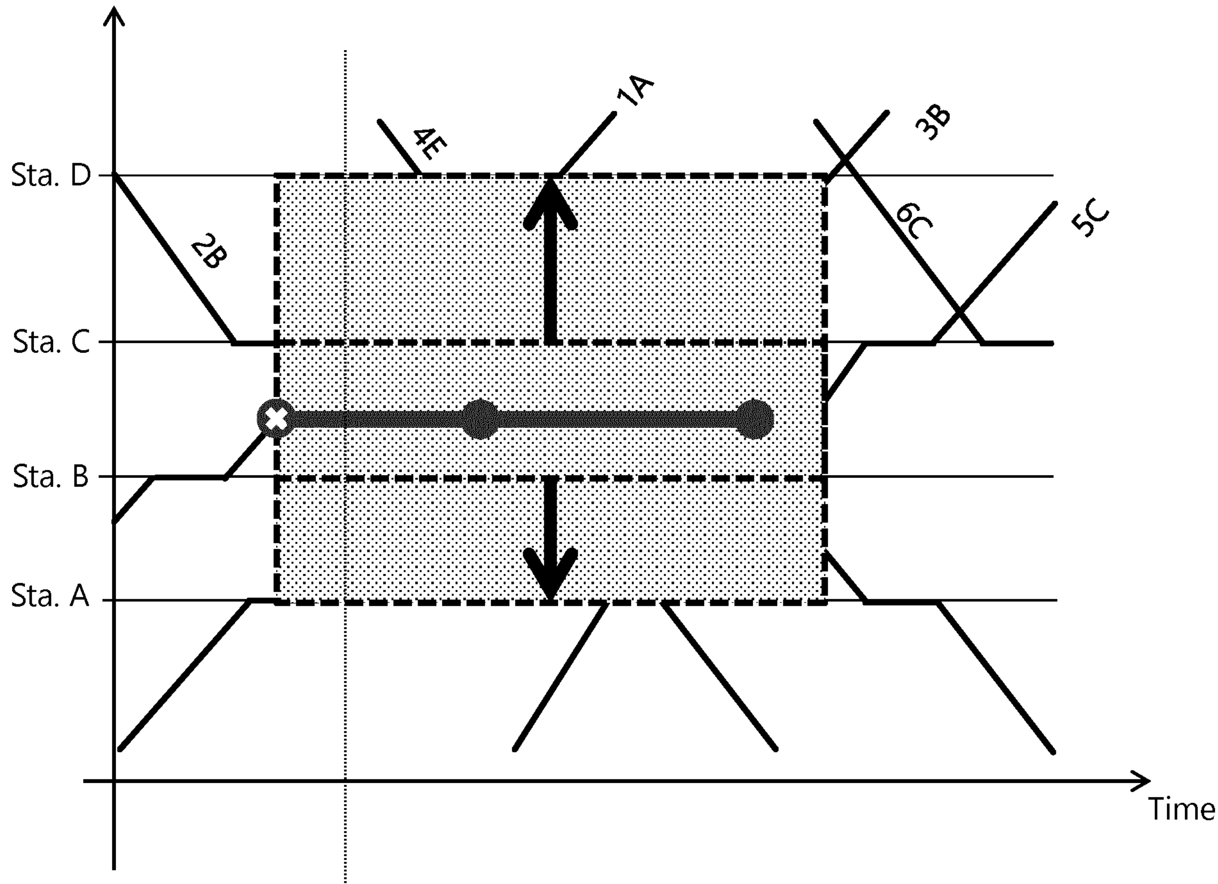


FIG. 6C

No.	Station	Reverse line running (using downward track)		Reverse line running (using upward track)	
		Starting station	Terminal station	Starting station	Terminal station
1	A	OK	OK	OK	OK
2	B	-	-	-	-
3	C	-	-	-	-
4	D	OK	OK	OK	OK
5	E	OK	OK	-	-
...	...	...	...	...	...

FIG. 7A

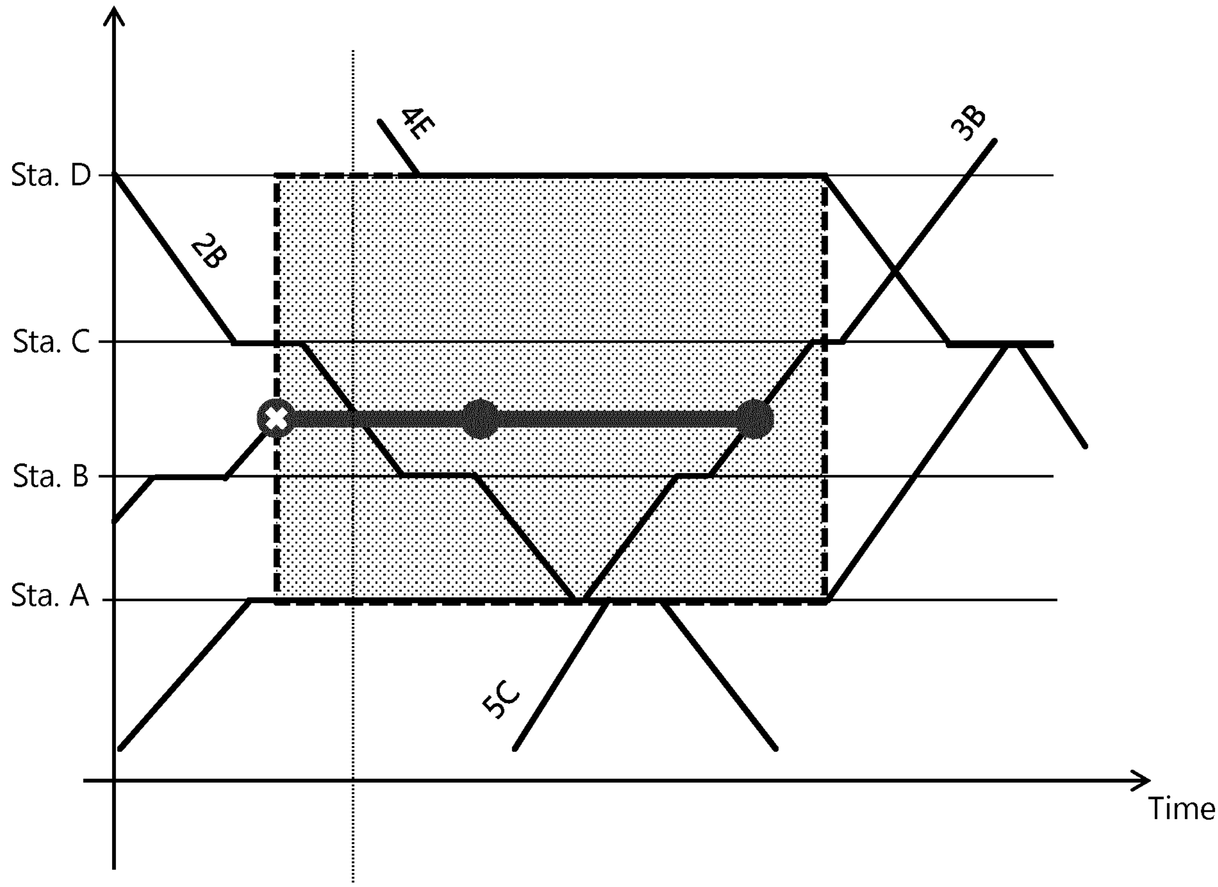


FIG. 7B

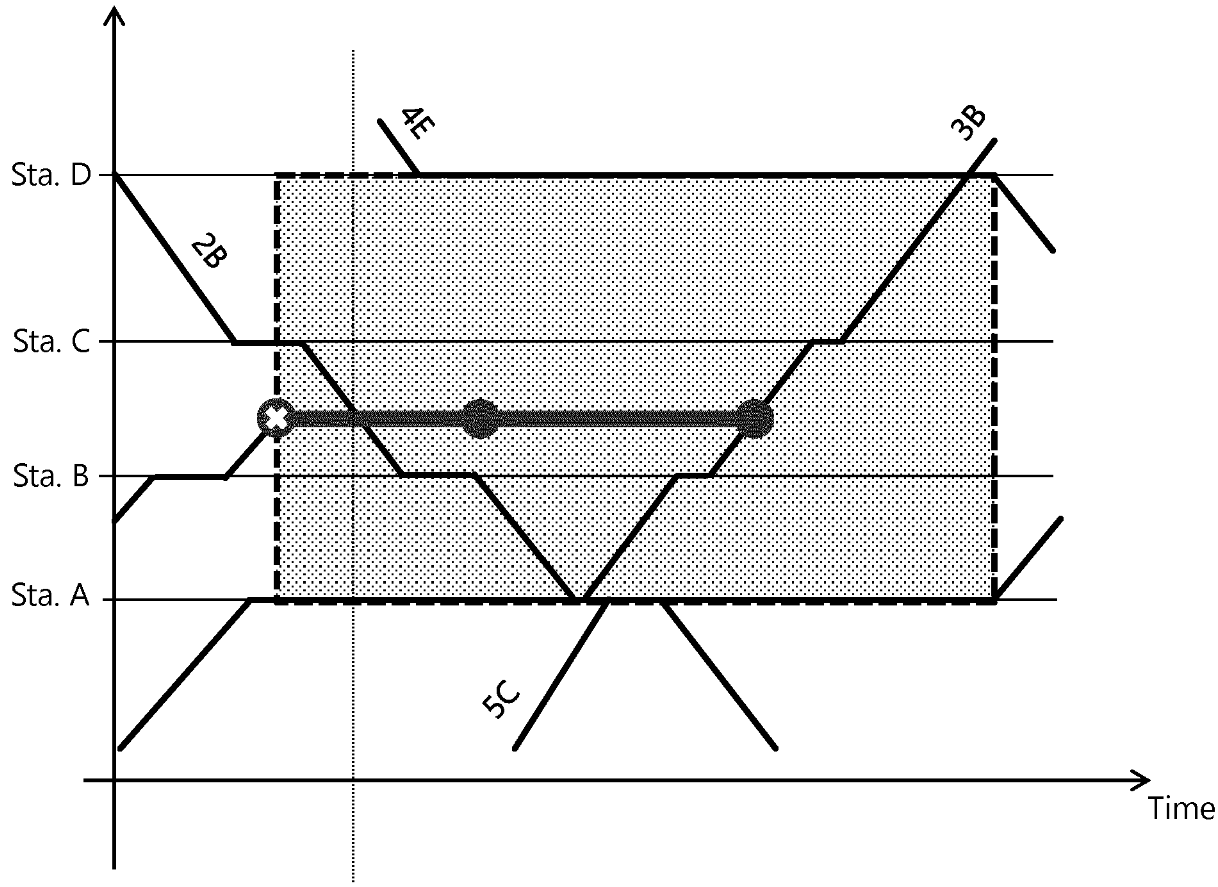


FIG. 7C

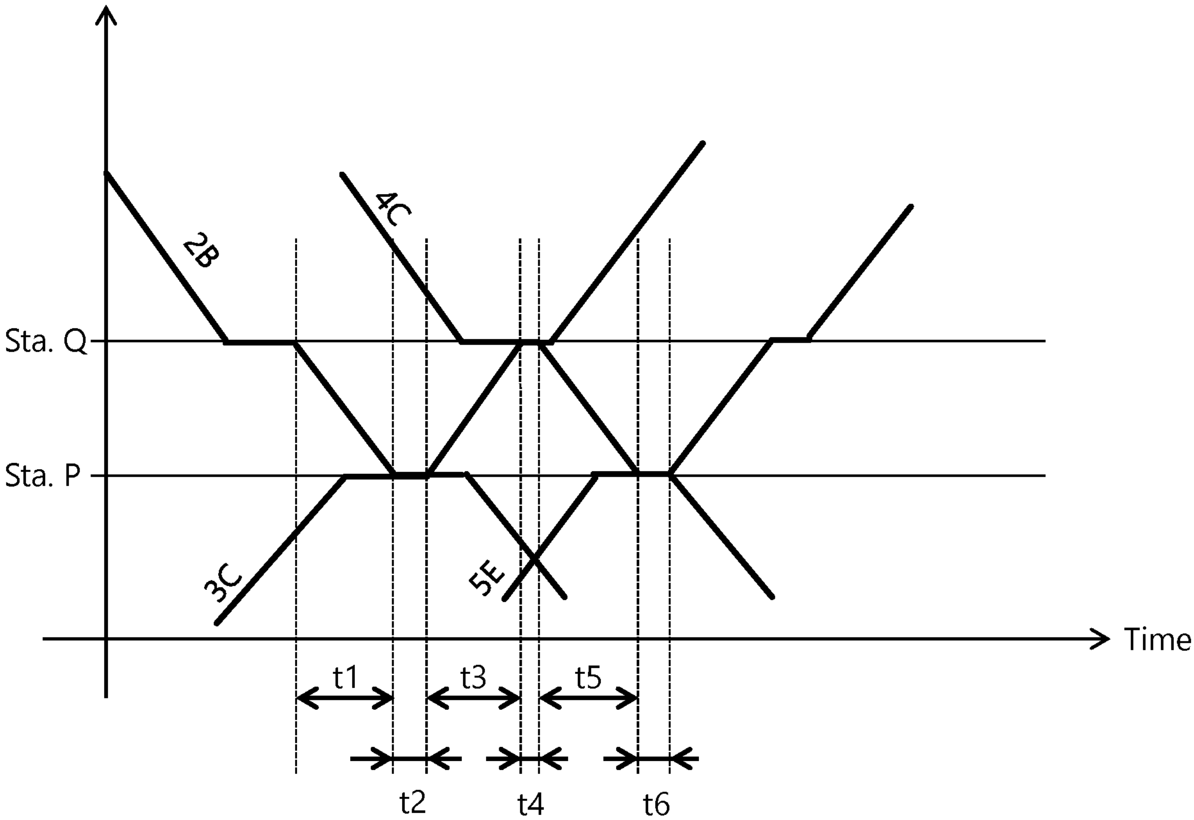


FIG. 7D

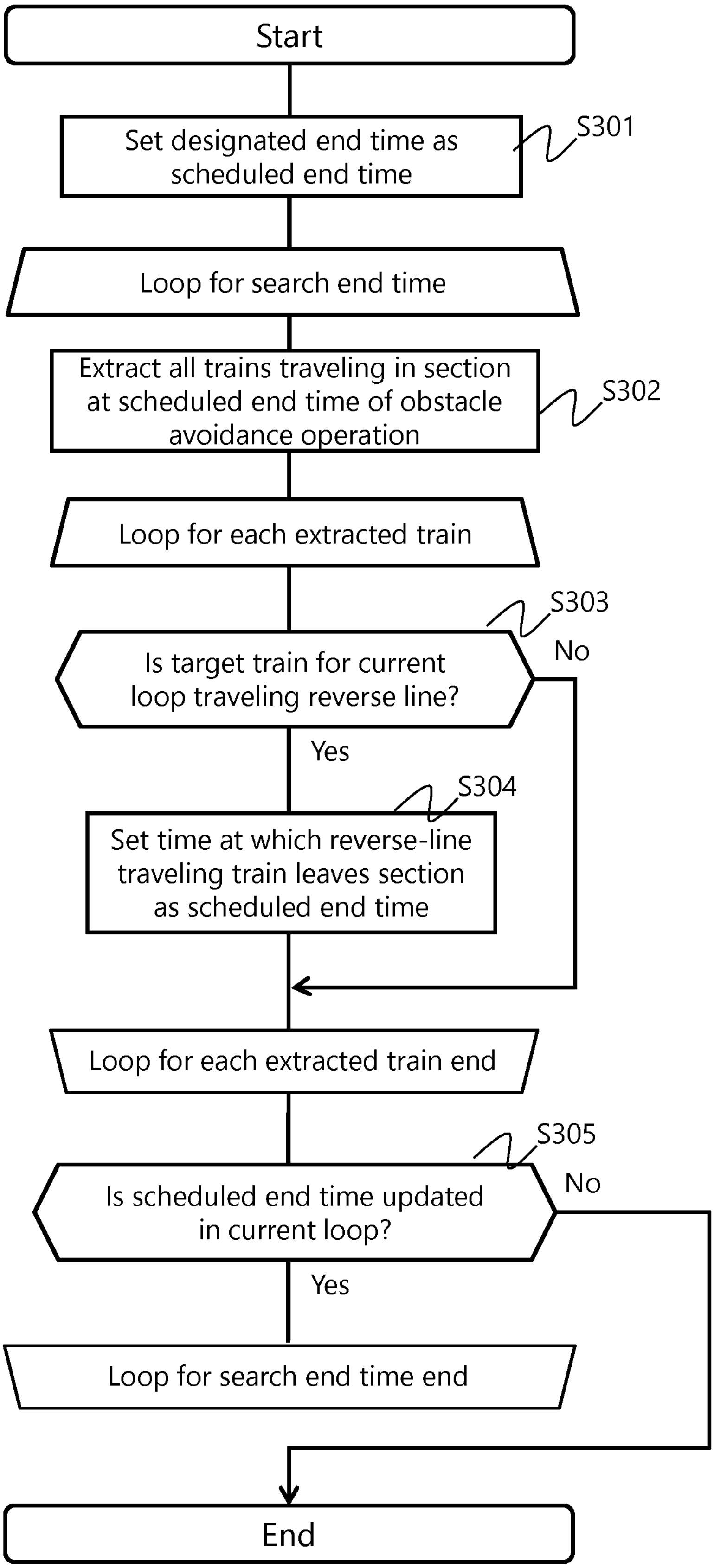

Start
Set designated end time as scheduled end time
S301
Loop for search end time
Extract all trains traveling in section at scheduled end time of obstacle avoidance operation
S302
Loop for each extracted train
S303
Is target train for current loop traveling reverse line?
No
Yes
S304
Set time at which reverse-line traveling train leaves section as scheduled end time
Loop for each extracted train end
S305
Is scheduled end time updated in current loop?
No
Yes
Loop for search end time end
End

FIG. 8A

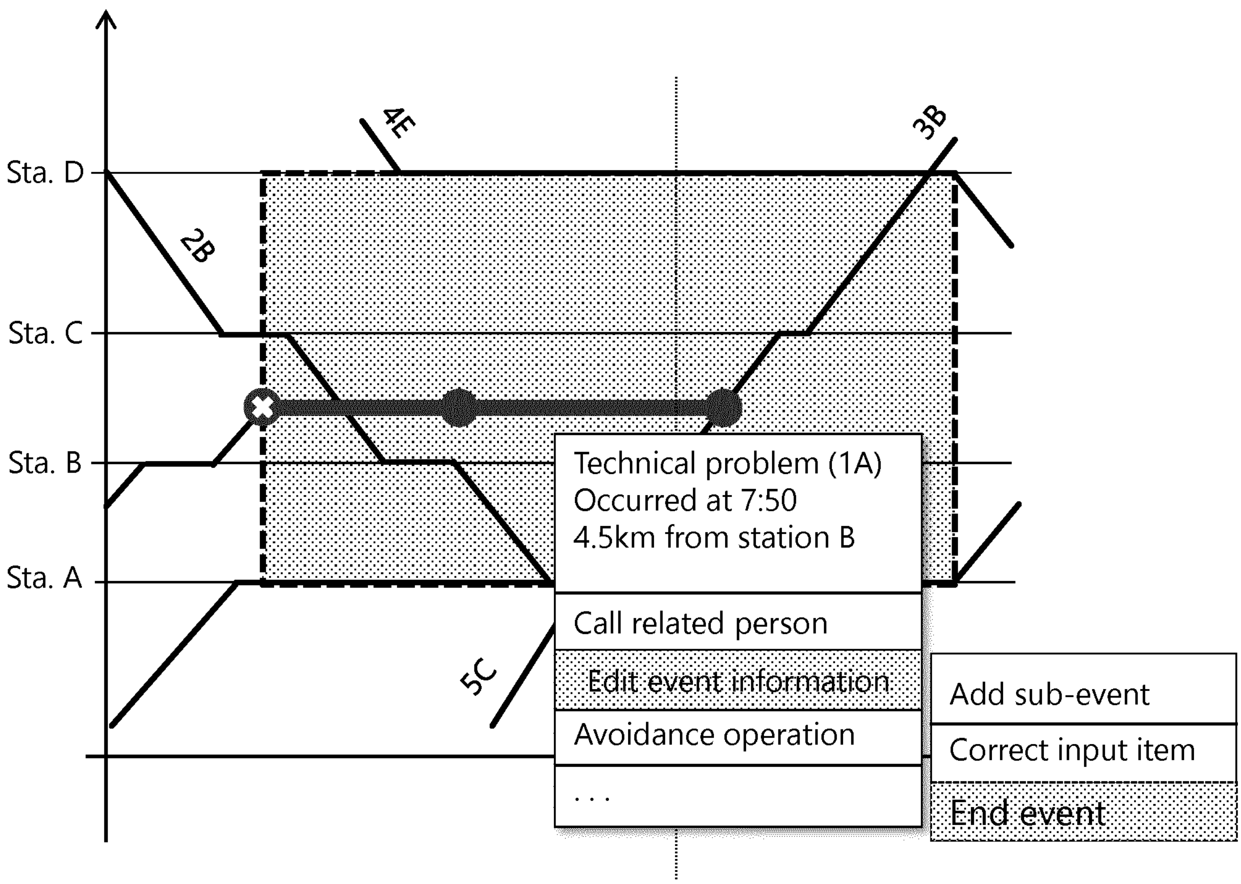

Sta. D
Sta. C
Sta. B
Sta. A
4E
3B
2B
5C
Technical problem (1A)
Occurred at 7:50
4.5km from station B
Call related person
Edit event information
Avoidance operation
. . .
Add sub-event
Correct input item
End event

FIG. 8B

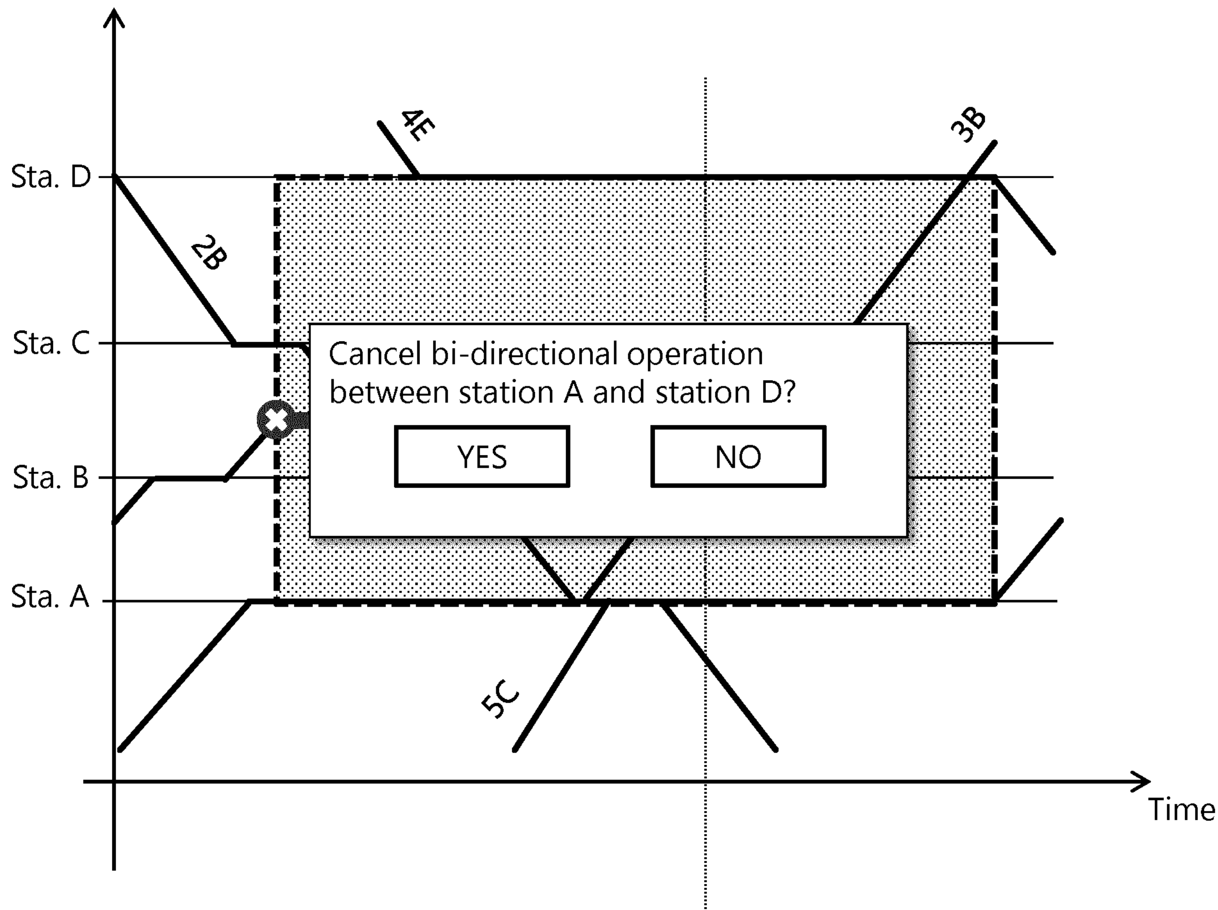

Sta. D
Sta. C
Sta. B
Sta. A
4E
3B
2B
5C
Cancel bi-directional operation between station A and station D?
YES
NO
Time

FIG. 9A

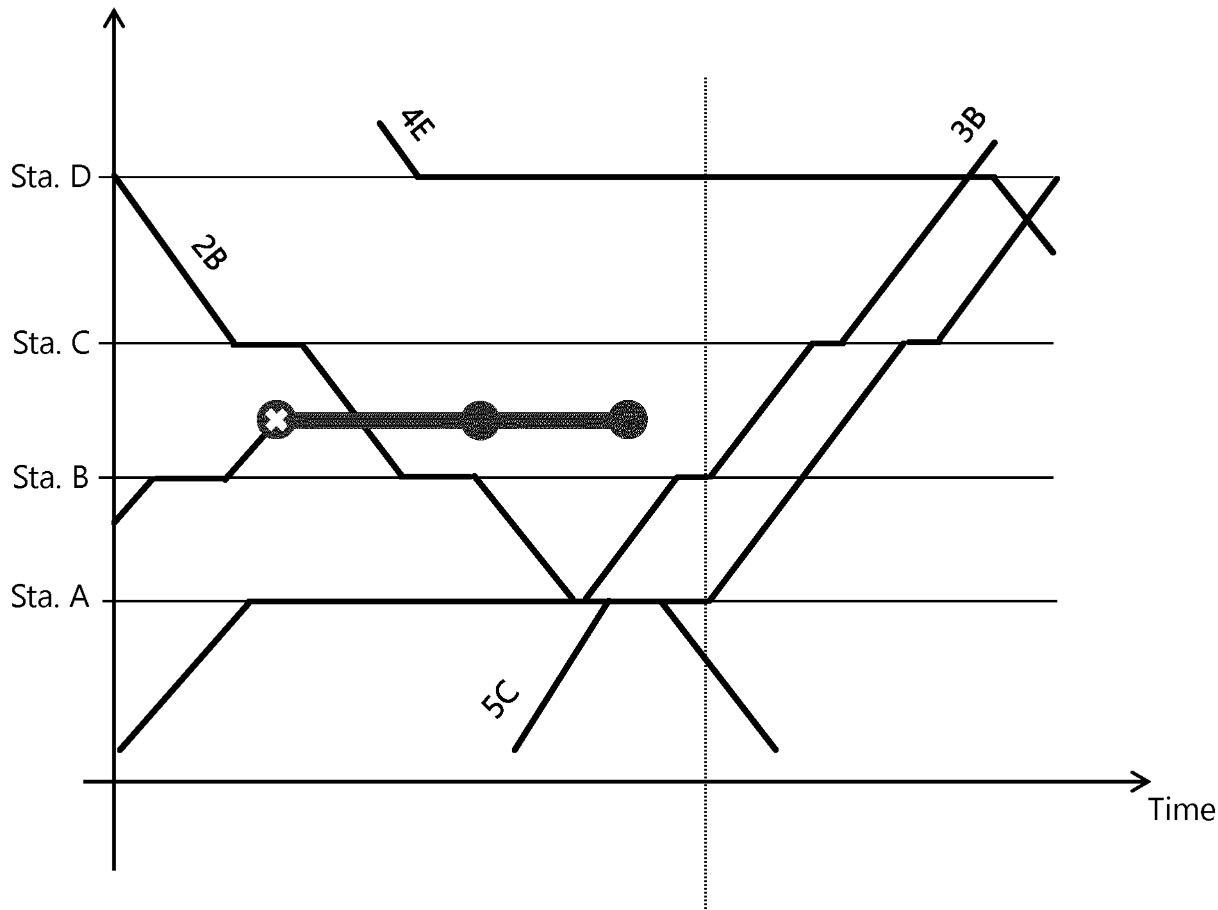


FIG. 9B

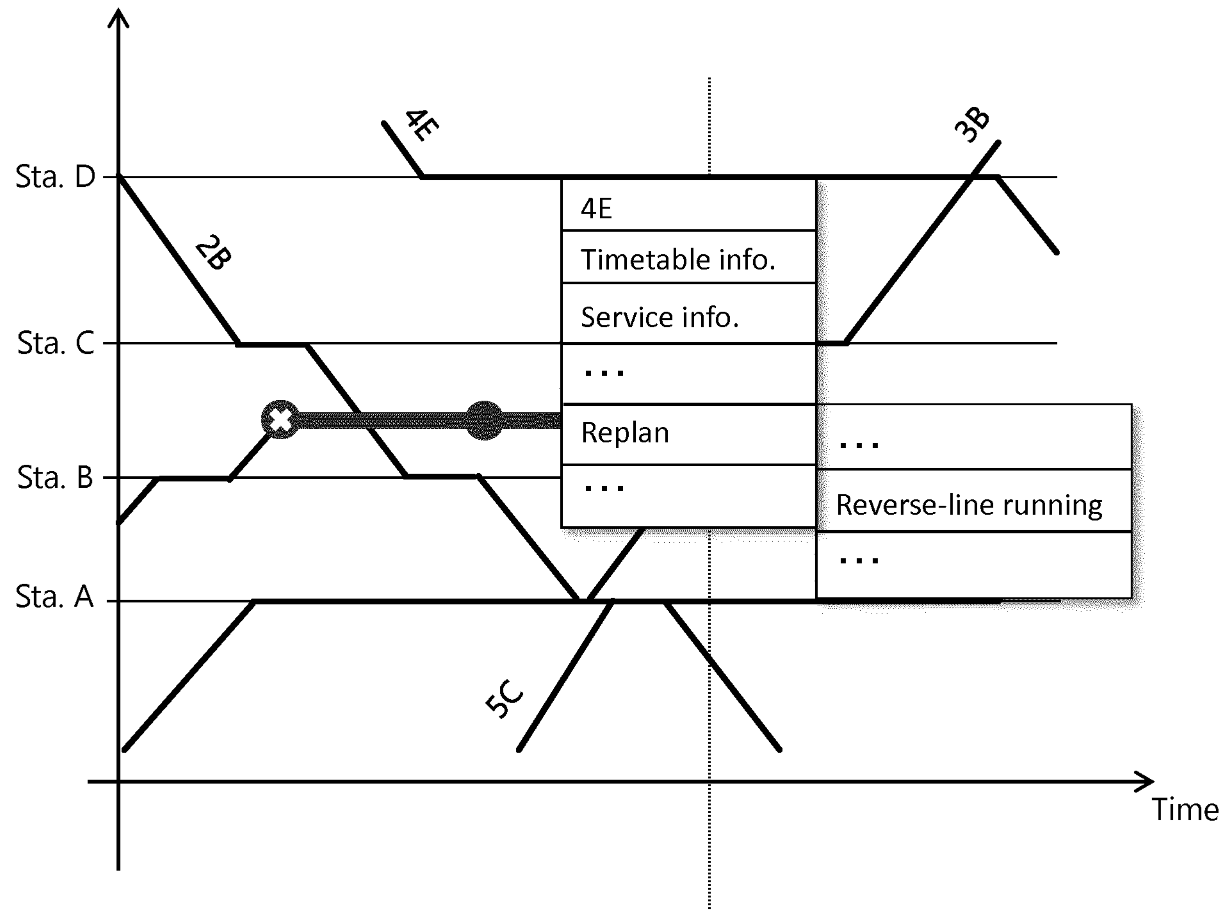

Sta. D
Sta. C
Sta. B
Sta. A
4E
3B
2B
5C
Time
4E
Timetable info.
Service info.
...
Replan
...
...
Reverse-line running
...

FIG. 9C

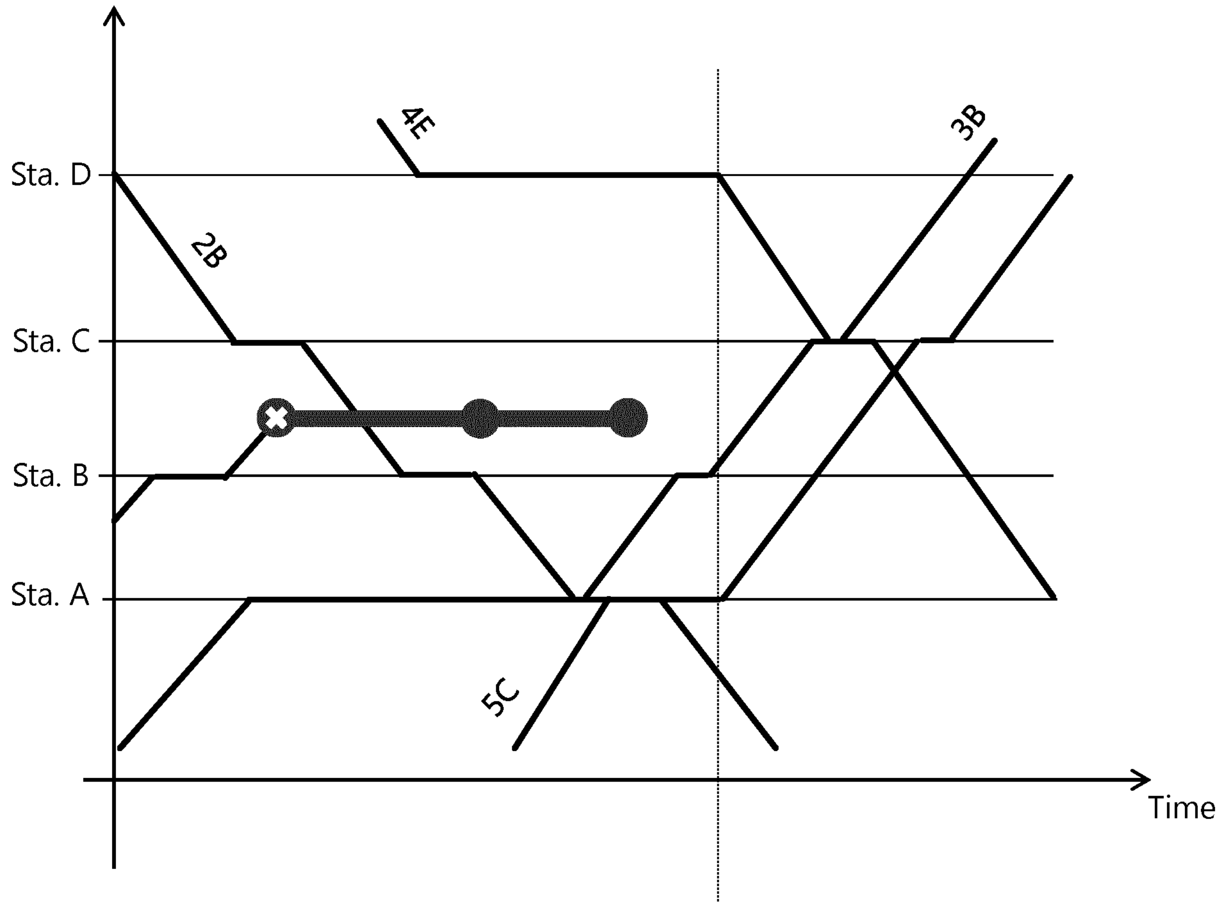


FIG. 10A

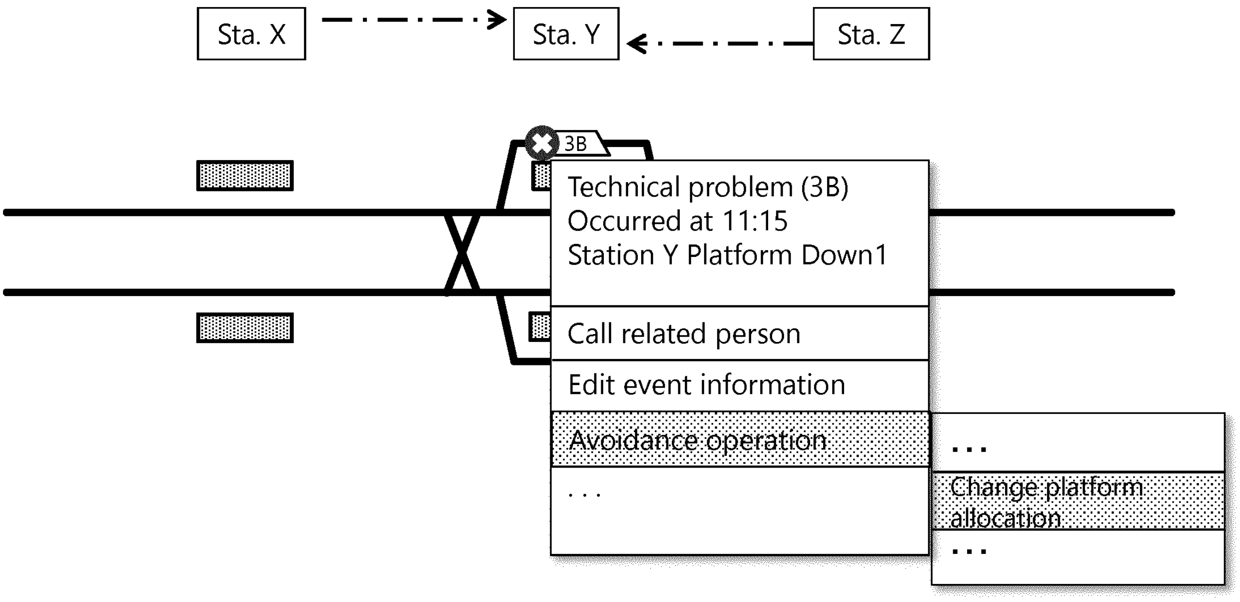

Sta. X
Sta. Y
Sta. Z
3B
Technical problem (3B)
Occurred at 11:15
Station Y Platform Down1
Call related person
Edit event information
Avoidance operation
. . .
. . .
Change platform allocation
. . .

FIG. 10B

No.	Virtual platform	Physical platform	
		Before change	After change
1	Down2	1	2
2	Down1	2	2
3	Up1	3	3
4	Up2	4	4

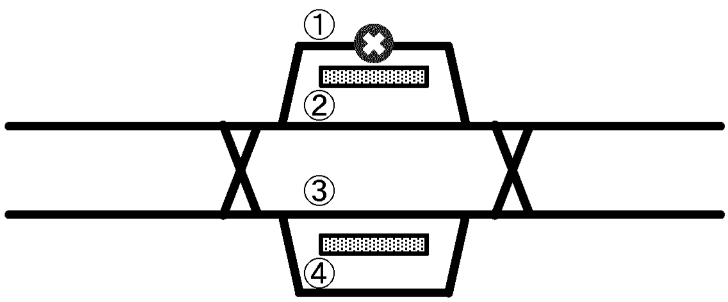


FIG. 10C

No.	Sta.	Arrival time	Departure time	Virtual platform	Physical platform	Running line
1	A	—	7:15:00	Down 1	—	Down
2	B	—	7:26:30	Nonstop down	—	Down
3	C	—	7:29:45	Down 1	—	Down
4	D	7:34:00	7:34:45	Up 1	—	Up
5	E	—	7:40:00	Nonstop up	—	Up
6	F	7:45:00	7:47:00	Up 2	—	Down
7	G	7:50:15	7:51:00	Down 1	1	Down
8	H	7:58:30	—	Up 1	4	—

FIG. 11

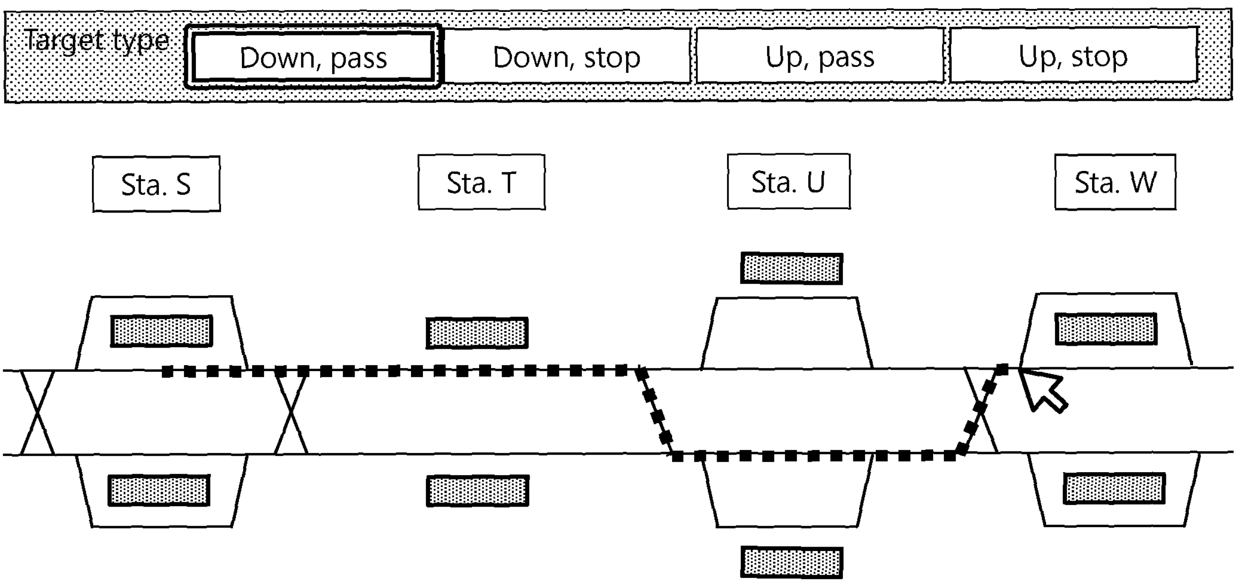

Target type
Down, pass
Down, stop
Up, pass
Up, stop
Sta. S
Sta. T
Sta. U
Sta. W

FIG. 12

7:53 Input obstacle occurrence info. | Dispatcher ○○
Train : 1A / Position : 4.5km from Sta. B / Time : 7:50

7:53 Specified obstacle influence range | Automatic calculation by system
Train hold range : Downward(Sta. A and Sta. B)
Attention calling range : Downward(Sta. Z ~ Sta. C), Upward(Sta. D ~ Sta. B)

7:55 Input estimated start time of first aid | Dispatcher △△
First aid will start at 8:15

8:01 Obstacle cause identified | Train 1A crew
Due to technical problem on device xx. Cannot move.

⋮

8:10 Checking obstacle avoidance plan | Dispatcher □□
Bi-directional operation using upward track between Sta. A and Sta. D

8:13 Timetable change info. | Dispatcher □□
Bi-directional operation using upward track between Sta. A and Sta. D
Influence : Train 3B departs sta. A 20 min. behind
Train 4E departs sta. D 35 min. behind
...

⋮

FIG. 13A

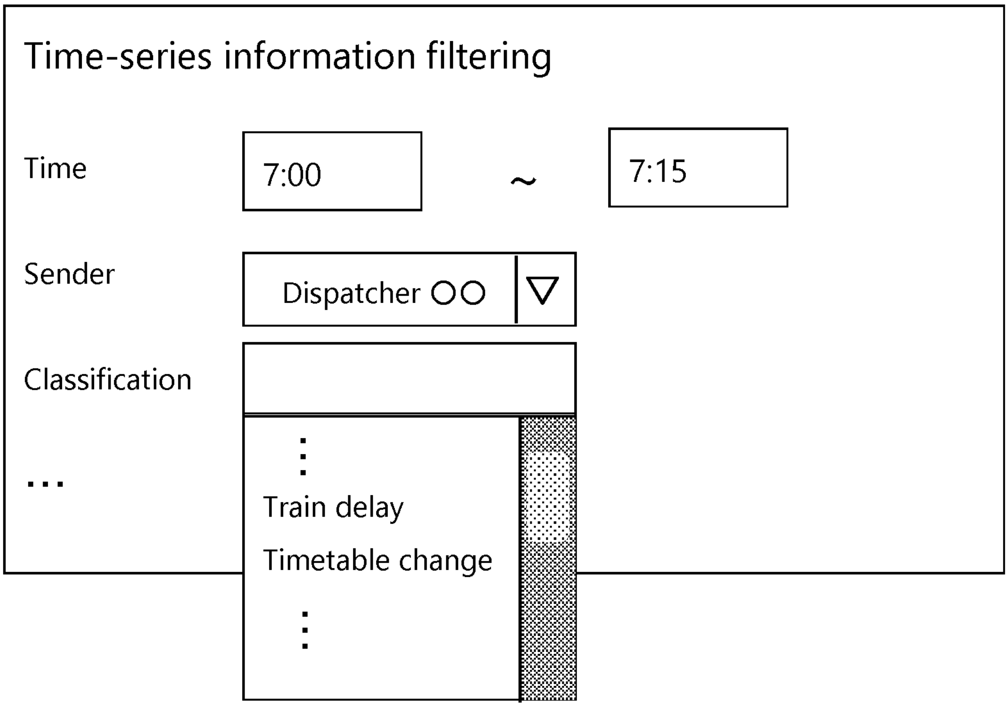
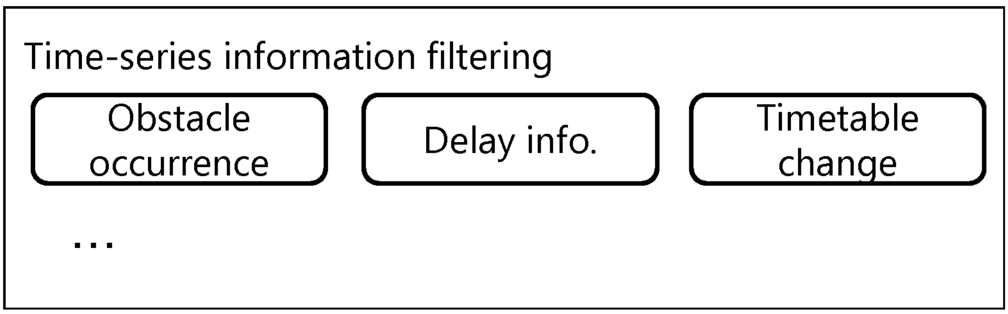


FIG. 13B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/062694

A. CLASSIFICATION OF SUBJECT MATTER
B61L27/00(2006.01)i, *G06Q50/30*(2012.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B61L27/00, G06Q50/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-95111 A (Hitachi, Ltd.), 04 April 2000 (04.04.2000), paragraphs [0016] to [0037]; all drawings (Family: none)	1-5
Y	JP 4-297366 A (Mitsubishi Electric Corp.), 21 October 1992 (21.10.1992), paragraphs [0006] to [0018]; all drawings (Family: none)	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2016 (12.07.16)	02 August 2016 (02.08.16)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/062694

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Document 1: JP 4-297366 A (Mitsubishi Electric Corp.), 21 October 1992 (21.10.1992), paragraphs [0006] to [0018]; all drawings (Family: none)

Claims are classified into the following three inventions.

(Continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-5

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2016/062694

Continuation of Box No.III of continuation of first sheet(2)

(Invention 1) claims 1-5

Claims 1-5 have the special technical feature of "an operation management system comprising: a display unit that displays a train line screen that represents train movement over time by means of a diagram using a time direction axis and a route direction axis on a plane; and a processing unit that, upon designation of a failure avoidance operation type which is a type of failure avoidance operation for operating a train by avoiding a failure, and, in the train line screen, a failure avoidance operation time band which is a time band for applying the failure avoidance operation and a failure avoidance operation area in which the failure avoidance operation is to be applied, drafts a train operation plan such that the train is operated in the failure avoidance operation time band and the failure avoidance operation area in an operation mode of the failure avoidance operation type, and causes a train schedule based on the train operation plan to be displayed in the train line screen". Accordingly, the claims are classified into Invention 1.

(Invention 2) claims 6-7

Claims 6-7 have a common technical feature with claim 1, classified into Invention 1, of "an operation management system comprising a display unit and a processing unit".

However, the above-said technical feature cannot be considered to be a special technical feature, since the technical feature does not make a contribution over the prior art in the light of the contents disclosed in the document 1 (particularly, see paragraph [0012]).

Further, there is no other same or corresponding special technical feature between claims 6-7 and claim 1.

In addition, claims 6-7 are not dependent on claim 1.

Further, claims 6-7 have no relationship such that these claims are substantially same as or equivalent to any claim classified into Invention 1.

Consequently, claims 6-7 cannot be classified into Invention 1.

Claims 6-7 have the special technical feature of "an operation management system comprising: a display unit that displays an existing line screen indicating an existing line position of a train at the current time on the tracks; and a processing unit that, in the event of a failure on the tracks, displays to-be-warned stations in the existing line screen, the to-be-warned stations including the next station forwardly of a failure occurrence position which is the position in which the failure has occurred, and stations between the failure occurrence position and, trailing back the route, the station at which a train moving toward the failure occurrence position can be returned back in the opposite direction". Accordingly, the claims are classified into Invention 2.

(Invention 3) claims 8-11

Claims 8-11 have a common technical feature with claim 1, classified into Invention 1, and claims 6-7, classified into Invention 2, of "an operation management system comprising a display unit and a processing unit".

However, the above-said technical feature cannot be considered to be a special technical feature, since the technical feature does not make a contribution over the prior art in the light of the contents disclosed in the document 1 (particularly, see paragraph [0012]).

Further, there is no other same or corresponding special technical feature between claims 8-11 and claim 1 or 6.

(Continued to next extra sheet)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/062694

In addition, claims 8-11 are not dependent on any one of claims 1 and 6.

Further, claims 8-11 have no relationship such that these claims are substantially same as or equivalent to any claim classified into Invention 1 or 2.

Consequently, claims 8-11 cannot be classified into either Invention 1 or Invention 2.

Claims 8-11 have the special technical feature of "an operation management system comprising: a display unit; a storage unit holding track number allocation management information associating a virtual track number comprising information defining direction and use for each track number, with a physical track number indicating each track number physically; and a processing unit that drafts a train operation plan such that the physical track number associated with the virtual track number is used in the direction and for the use of the virtual track number". Accordingly, the claims are classified into Invention 3.

Form PCT/ISA/210 (extra sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 6072333 A **[0004]**