



(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

- (43) Date of publication:
25.07.2018 Bulletin 2018/30

(51) Int Cl.:
B61L 27/00^(2006.01)
- (21) Application number: 15904120.1

(86) International application number:
PCT/JP2015/076603
- (22) Date of filing: 18.09.2015

(87) International publication number:
WO 2017/046933 (23.03.2017 Gazette 2017/12)

(84) Designated Contracting States: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA ME Designated Validation States: MA	(72) Inventors: • UCHIYAMA, Ryohsuke Tokyo 100-8280 (JP) • SATOU, Noboru Tokyo 100-8280 (JP) • FUSHIKI, Takumi Tokyo 100-8280 (JP)
(71) Applicant: Hitachi, Ltd. Tokyo 100-8280 (JP)	(74) Representative: Strehl Schübel-Hopf & Partner Maximilianstrasse 54 80538 München (DE)

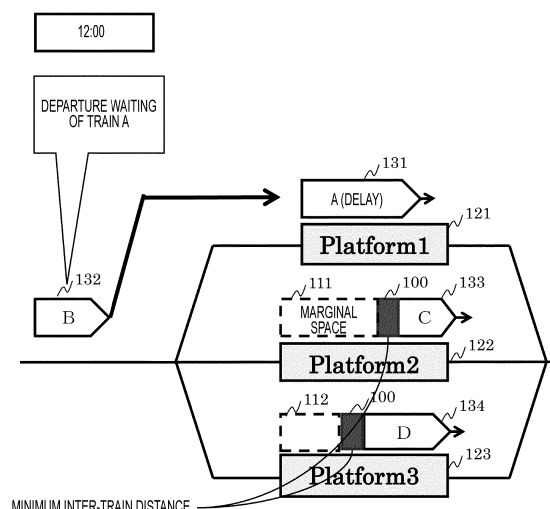
(54)

OPERATION RESCHEDULING SUPPORT APPARATUS AND SYSTEM

(57) As an operation arrangement method for delay recovery at the time of disorder in schedule or the like, provided is a technique capable of changing track to a platform even in a case where another train has been stopped on the platform which the track is to be changed to.

An operation arrangement support apparatus includes: travel management means acquiring an on-track position of a traveling train and an actual schedule indicating a travel record of the train; prediction calculation means calculating a predicted schedule indicating the operation prediction of the train from the on-track position; track change propriety determination means acquiring train length information of the train, track length information indicating a length of the platform as a candidate for arrival of the train, and train length information of another train that has stopped at the platform or is predicted to stop in the future based on the actual schedule and the predicted schedule, comparing the train length information of the train, the track length information, and the train length information of the other train, and determining a train occupancy situation of the platform; and information display means displaying the train occupancy situation.

FIG. 3



Description**BACKGROUND OF THE INVENTION****1. Field of the Invention**

[0001] The present invention relates to an operation management system, and particularly, to an operation arrangement support apparatus and system for supporting operation arrangement.

2. Description of the Related Art

[0002] In an operation management system, when travel delay of a train occurs, operation arrangement is performed as means for eliminating the delay. As a typical method of operation arrangement for delay elimination, there exists operation arrangement that changes an arrival destination platform of the train which is planned in advance.

[0003] In the case of changing the arrival destination platform, the user determines whether or not there exists another train on the change destination platform or whether or not there exists any train scheduled to arrive at the same time and, after that, changes the arrival destination platform.

[0004] JP 2008-222004 A (Operation arrangement apparatus of operation management system) discloses that, in order to support user's determination, "an operation arrangement proposal function generates one or more operation arrangement plans that can avoid troubles based on a predicted schedule predicted by a prediction simulation function further with reference to operation arrangement knowledge, a first planned schedule, and operation arrangement information and presents the generated operation arrangement plan as a proposal to a commander via a man-machine interface".

SUMMARY OF THE INVENTION

[0005] JP 2008-222004 A (Operation arrangement apparatus of operation management system) does not assume a case where a train is allowed to enter a platform on which another train has already stopped and a commander perform operation arrangement based on track change. Therefore, according to the operation arrangement method based on the track change in the related art, in a case where another train has already stopped at the platform on which the own train arrives, the own train is allowed to be stopped outside the platform, and after the other train departs from the platform, the own train is allowed to enter the platform. Therefore, there exists a problem in that the own train is in a waiting state and the delay cannot be recovered efficiently.

[0006] The present invention is to perform efficient delay recovery by supporting operation arrangement allowing a plurality of trains to enter one platform.

[0007] A configuration in an embodiment of the present

invention includes:

travel management means acquiring an on-track position of a traveling train and an actual schedule indicating a travel record of the train;
prediction calculation means calculating a predicted schedule indicating the operation prediction of the train from the on-track position;
track change propriety determination means acquiring train length information of the train, track length information indicating a length of the platform as a candidate for arrival of the train, and train length information of another train that has stopped at the platform or is predicted to stop in the future based on the actual schedule and the predicted schedule, comparing the train length information of the train, the track length information, and the train length information of the other train, and determining a train occupancy situation of the platform; and
information display means displaying the train occupancy situation.

[0008] According to the present invention, efficient delay recovery can be performed by supporting operation arrangement allowing a plurality of trains to enter one platform.

BRIEF DESCRIPTION OF THE DRAWINGS**[0009]**

Fig. 1 illustrates an example of an overall configuration diagram of an operation arrangement support system;

Fig. 2 illustrates a block diagram of a processing device;

Fig. 3 illustrates an example of a schematic diagram in which four trains travel within the same station;

Fig. 4-1 illustrates a configuration example of a schedule data table;

Fig. 4-2 illustrates a configuration example of a data table;

Fig. 4-3 illustrates a configuration example of a track data table;

Fig. 5 is an overall flowchart illustrating an example of a calculation unit;

Fig. 6 is a flowchart of a process illustrating an example of a prediction calculation unit;

Fig. 7 is a flowchart of a process illustrating an example of an operation arrangement proposal unit;

Fig. 8 is a flowchart of a manual process illustrating an example of a track change propriety determination processing unit;

Fig. 9 is a flowchart of an automatic process illustrating an example of a track change propriety determination processing unit;

Fig. 10 illustrates a screen example 1 to be output to an output device;

Fig. 11 illustrates a screen example 2 to be output to an output device;

Fig. 12 illustrates an example of manipulation of manual operation arrangement in the screen example 1;

Fig. 13 illustrates an example of manipulation of manual operation arrangement in the screen example 2; and

Fig. 14 illustrates an example of automatic operation arrangement in the screen example 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Hereinafter, embodiments of the present invention will be described with reference to the drawings. The embodiments will be described on the assumption that an operation arrangement support apparatus in a railway operation management system is an object of application.

First example

[0011] Fig. 1 illustrates an example of an overall configuration diagram of an operation arrangement support system. The operation arrangement support system 1 according to this embodiment is configured on a computer system and a computer program of the operation arrangement support apparatus 1000 and includes a database 1100 that stores data such as schedules, a calculation unit 1200 that executes the program, an input device 1300 that receives an input from a user, and an output device 1400 that performs displaying of schedule stripes or the like to the user. In addition, the operation arrangement support apparatus 1000 cooperates with on-site equipment of a track switch 4 and a signal machine 5 from an interlocking device 2 via a network 3 to perform travel management of a train 6.

[0012] The database 1100 includes a schedule data table 1110 retaining a schedule data of a planned time, an actual time, and a predicted time of train travel or a provisional time generated at the time of operation arrangement for each of trains and arrival and departure platforms, a train data table 1120 retaining a train length of each train, and a track data table 1130 retaining a track length of each platform. In addition, the information stored in the database 1100 may be configured to be stored in a data server (not shown) connected to the network and to be called up by the computer as necessary.

[0013] The calculation unit 1200 reads stored information in the database 1100 and executes programs and the like. In addition, in some cases, the calculation unit 1200 may be referred to as a central processing unit (CPU). In this example, a prediction calculation unit of the calculation unit 1200 denotes a program, and the calculation unit 1200 executes programs such as a prediction calculation unit, so that various functions of the operation arrangement support system 1 can be imple-

mented.

[0014] The input device 1300 is an input device such as a mouse or a keyboard similarly to a typical computer. The output device 1400 is an output device such as a display.

[0015] Fig. 2 illustrates a block diagram of the calculation unit 1200.

[0016] The calculation unit 1200 includes a prediction calculation unit 1210 that calculates a predicted time of train travel, an operation arrangement proposal unit 1220 that automatically generates an operation arrangement plan capable of achieving delay recovery based on the calculated predicted time, an operation arrangement unit 1230 that processes an operation arrangement proposal generated by the operation arrangement proposal unit 1220 or an operation arrangement plan input from the input device 1300, displays information necessary for the operation arrangement, and changes the schedule data table based on the executed operation arrangement plan, a track change propriety determination processing unit 1240 that determines whether or not the train can be accommodated in a platform as a change destination candidate at the time of generating an operation arrangement plan, an information display unit 1250 that displays information for supporting the operation arrangement such as a schedule, a train length, and a track length to the output device 1400, and a travel management unit 1260 that checks a travel condition of the train and updates the actual schedule.

[0017] Fig. 3 is a diagram illustrating an example in which four trains (a train A 131, a train B 132, a train C 133, and a train D 134) travel within the same station. A specific example will be described with reference to Fig. 3.

[0018] The train A 131 arrived at Platform 1 at a time later than the planned arrival time and stopped, the train B 132 stopped outside Platform 1 which was the planned arrival destination, the train C 133 arrived at Platform 2 at the planned arrival time, and the train D 134 arrived at Platform 3 at the planned arrival time and stopped.

[0019] At this time, it is assumed that the train B 132 is scheduled to travel to Platform 1 which is the arrival destination platform. However, since the train A 131 has already stopped at Platform 1 due to the occurrence of delay, the train B 132 cannot travel to Platform 1 until the train A 131 departs. Therefore, the train B 132 is in a state of waiting until the departure of the train A 131. As a result, similarly to the train A 131, it is predicted that travel delay of the train B 132 occurs.

[0020] Herein, as an operation arrangement plan for eliminating the travel delay of the train B 132, Platform 2 which is another platform having a marginal space length capable of accommodating the train B 132 is changed as an arrival destination. As a result, the delay of the train B 132 can be reduced. In addition, since Platform 3 has no marginal space length capable of accommodating the train B 132, Platform 3 cannot be changed as an arrival destination.

[0021] That is, in this example, in a case where the travel delay of the train occurs, as an operation arrangement plan for eliminating the delay, by changing the platform having a marginal space length capable of accommodating the delayed train as an arrival destination, the delayed train can travel without stopping outside the platform. Furthermore, the influence of the delay on the other trains traveling behind the delayed train can also be reduced, and thus, it is possible to implement more efficient transportation work.

[0022] Fig. 4-1 is a diagram illustrating an example of the schedule data table 1110 in this embodiment. The schedule data table 1110 stores a planned schedule 1111 indicating an initial travel plan of a train, an actual schedule 1112 indicating a travel record of the train, a predicted schedule 1113 predicting the future travel of the train, and a provisional schedule 1114 generated at the time of operation arrangement. In addition, each schedule of the schedule data table 1110 stores a train number, arrival and departure platform numbers, and an arrival time and a departure time of a train with respect to a platform. Herein, in this example, the current time is set to 12:00.

[0023] The actual schedule 1112 is generated by the travel management unit 1260 when the train arrives at or departs from a platform.

[0024] From the actual schedule 1112, the train A arrived at Platform 1 at 11:58, and delay occurred by 4 minutes from 11:54 which is the arrival time of the planned schedule.

[0025] The predicted schedule 1113 is generated by the prediction calculation unit 1210 from the travel record of the train. However, herein, as seen from the predicted schedule (before the operation arrangement) in a case where the measures of delay reduction such as the operation arrangement described in Fig. 4-1 are not applied, the predicted arrival time of the train B is 12:03, and thus, delay occurs by 3 minutes from 12:00 which is the arrival time of the planned schedule of the train B.

[0026] This is because the train B is forced to stop outside the platform until the train A which has stopped at the arrival destination platform departs from the platform, that is, until 12:02.

[0027] Fig. 4-2 is a diagram illustrating an example of the train data table 1120 in this embodiment. The train data table 1120 stores a train length of each train.

[0028] Fig. 4-3 is a diagram illustrating an example of the track data table 1130 in this embodiment. The track data table 1130 stores a track length of each track (platform) of the station.

[0029] Next, processes of each component of the calculation unit 1200 will be described.

[0030] As illustrated in Fig. 5, the calculation unit 1200 activates the prediction calculation unit 1210 and calculates the predicted time of the train travel (S1) (details will be described later with reference to Fig. 6). Next, the calculation unit 1200 performs processes of the case of automatically generating an operation arrangement plan

or processes of the cases of manually generating an operation arrangement plan (S2).

[0031] In the case of manually generating the operation arrangement plan, the operation arrangement unit 1230 reads the train selected from the input device 1300 (S3) and determines the read train to be a track change target train on which the operation arrangement is performed (S4). Next, the track change propriety determination processing unit 1240 determines whether or not the track change target train can be accommodated in the platform as the change destination candidate (S6) (details will be described later with reference to Fig. 8).

[0032] In the case of automatically generating the operation arrangement plan, the operation arrangement proposal unit 1220 selects the track change target train on which the operation arrangement is performed based on the calculated predicted time (S5) (details will be described later with reference to Fig. 7). At this time, the track change propriety determination processing unit 1240 determines whether or not the track change target train can be accommodated in the change destination candidate platform, on the basis of a train occupancy situation of the platform as the change destination candidate by the track change target train (S6) (details will be described later with reference to Fig. 9).

[0033] After the track change propriety determination process, the operation arrangement unit 1230 generates the operation arrangement plan (S7). Then, the information display unit 1250 allows the output device 1400 to display information that supports the operation arrangement such as the train length, the train length, and the train occupancy situation of the change destination candidate platform or the necessity to execute the operation arrangement plan (S8 and S9). In a case where it is necessary to execute the operation arrangement plan, the operation arrangement unit 1230 reflects the operation arrangement plan on the schedule data table (S10).

[0034] As illustrated in Fig. 6, the prediction calculation unit 1210 reads a planned schedule and an actual schedule defined for each train (S101), calculates a difference between an arrival time and a departure time of the planned and actual schedules (S102), calculates a predicted arrival time at the platform and a predicted departure time from the platform for each train (S103), and writes the calculated predicted time in the schedule data table to generate a predicted schedule (S104).

[0035] For example, in a case where a train arrived at the platform at a time by two minutes later than a planned time, the difference between the planned time and the actual time is 2 minutes, and as long as delay recovery is not performed, a predicted schedule that the arrival time of the next platform of this train is predicted to be delayed by 2 minutes is generated. This operation is performed at a certain period.

[0036] As illustrated in Fig. 7, the operation arrangement proposal unit 1220 reads a planned time and an actual time of each train (S201), compares the planned time of each train with the arrival time or departure time

of the predicted time to calculates a difference (S202), and determines whether or not the difference is equal to or larger than a certain time (α) (S203). In a case where the difference is equal to or larger than a certain time interval (α), it is determined that there exists delay of the train, and an operation arrangement plan is generated based on track change for eliminating the delay (S204). At the time of generating the operation arrangement plan based on the track change, the track change propriety determination processing unit 1240 that performs the track change propriety determination process for determining whether or not the track change of the delayed train to each platform which is a track change destination candidate is enabled is called in advance (S205). In a case where it is determined that the track change to the platform is enabled, the operation arrangement proposal unit 1220 generates an operation arrangement plan which is a provisional schedule (S206). After that, the operation arrangement unit 1230 for executing the generated operation arrangement plan is activated (S207).

[0037] The operation arrangement unit 1230 executes the operation arrangement plan generated by the operation arrangement proposal unit. In addition, the manipulation information of the user input by the input device 1300 is read, and the track change propriety determination processing unit 1240 and the information display unit 1250 are executed according to the manipulation. In addition, the operation arrangement plan generated by the input device 1300 is executed.

[0038] In addition, the operation arrangement unit 1230 performs the following processes based on (1) the operation arrangement plan manually generated by the input device 1300 and (2) the operation arrangement plan automatically generated by the operation arrangement proposal unit 1220.

(1) The operation arrangement unit 1230 transmits the operation arrangement plan generated by performing manipulation of the manual operation arrangement on the input device 1300 to the information display unit 1250 and displays the provisional schedule reflecting the result of the operation arrangement on the output device 1400.

(2) The operation arrangement unit 1230 transmits the operation arrangement plan generated by the operation arrangement proposal unit 1220 to the information display unit 1250 and displays the provisional schedule reflecting the result of the operation arrangement on the output device 1400.

[0039] The user checks the reflection result of the displayed operation arrangement plan and manipulates the input device 1300 to instruct the operation arrangement unit 1230 to execute or cancel the operation arrangement. In a case where the user is to execute the operation arrangement displayed on the output device 1400, the operation arrangement unit 1230 reflects the displayed operation arrangement plan on the schedule data table.

[0040] The track change propriety determination processing unit 1240 determines the train occupancy situation of the platform which is the change destination candidate of the track change target train. More specifically, it is determined whether or not the platform which is the change destination candidate has a marginal space length capable of accommodating the track change target train, that is, whether or not there exists an empty space. In a case where it is determined that the platform as the change destination candidate has a marginal space length and can accommodate the track change target train, it assumed that the operation arrangement based on the track change is enabled. Details in the case of the manipulation of the manual operation arrangement will be described with reference to Fig. 8, and details in the case of the manipulation of the automatic operation arrangement will be described with reference to Fig. 9.

[0041] The information display unit 1250 displays, on the output device 1400, the information for supporting the operation arrangement such as the current time, the planned schedule, the predicted schedule, the provisional schedule, the track length, the train length, the propriety of accommodation of the track change destination candidate at the time of operation arrangement, the operation arrangement execute/cancel dialog and the train occupancy situation of the platform which is the change destination candidate.

[0042] The travel management unit 1260 writes, in the actual schedule of the schedule data table 1110, the time when the train defined in the schedule data table arrives at the platform or departs from the platform. Until the train arrives at the platform or departs from the platform, the arrival time and the departure time of the actual schedule becomes empty.

[0043] Fig. 10 illustrates a screen example 1 of the output device 1400 before the operation arrangement based on the schedule stripe in this embodiment.

[0044] In this embodiment, the schedule stripe is represented on the screen plane 201, the horizontal axis represents time, and the vertical axis represents travel position. On the left side 202 of the screen, the station name and the names of the platforms are illustrated. The schedule stripes are displayed so that predicted schedule stripes and planned schedule stripes can be distinguished. For example, dotted lines indicate predicted schedule stripes, and solid lines indicate planned schedule stripes. In addition, in a case where the planned schedule stripe and the predicted schedule stripe are coincident with each other, these schedule stripes are displayed to be superimposed. More specifically, the dotted lines indicate the predicted schedule stripe 221 of the train A and the predicted schedule stripe 222 of the train B, and the solid lines indicate the planned schedule stripe 211 of the train A and the planned schedule stripe 212 of the train B. In addition, since the planned schedule stripes and the predicted schedule stripes (223 and 224) of the train C and the train D are coincident with each other, these schedule stripes are displayed to be super-

imposed.

[0045] The information display unit 1250 acquires the current time from a computer system or a system set time and displays the current time on the output device 1400. As in this example, the display of the current time may be displayed as 12:00 as the time display 203, or one point with respect to the horizontal axis may be displayed as time display 204.

[0046] The information display unit 1250 acquires the planned schedule 1111 of each train from the schedule data table 1110 at a certain period and displays the planned schedule 1111 of each train on the output device 1400.

[0047] The information display unit 1250 acquires the predicted schedule 1113 of each train from the schedule data table 1110 at a certain period and displays the predicted schedule 1113 of each train on the output device 1400 with a dotted line.

[0048] The information display unit 1250 displays, on the output device 1400, a dashed line indicating the time in 2-minute intervals on the horizontal axis.

[0049] Fig. 12 illustrates an example of manipulation of the manual operation arrangement in the screen example 1 based on the schedule stripe in this embodiment.

[0050] Similarly to Fig. 10, the screen example 1 of this embodiment displays the screen plane 201, the screen left side 202, the current time display (203 and 204), the schedule stripe (211, 212, 221, 222, 223, and 224).

[0051] When the train is selected 241 by the user using the input device 1300, for example, the user points the predicted schedule stripe 222 of the train with the mouse pointer (mouse over), and the operation arrangement unit 1230 acquires the train length of the selected train B with the predicted schedule stripe 222 of the train from the train data table 1120. The operation arrangement unit 1230 transmits an instruction to display the acquired train length to the information display unit 1250. Then, the information display unit 1250 displays the acquired train length 242 of the train B on the output device 1400.

[0052] When the user selects 241 the predicted schedule stripe 222 of the train for which actual schedule of arrival to the platform defined as the departure platform has not been generated in the schedule data table 1110 by using the input device 1300, the user keeps clicking (picking) for example, by mouse manipulation. The operation arrangement unit 1230 determines that the picked train is a track change target and executes the track change propriety determination processing unit 1240.

[0053] As illustrated in Fig. 8, the flow of processes of the track change propriety determination processing unit 1240 at the time of performing the manual operation arrangement will be described.

[0054] The track change propriety determination processing unit 1240 determines whether or not the track change of the platform/time which is the track change destination candidate of the picked train is enabled.

[0055] The track change propriety determination processing unit 1240 determines whether or not each

platform which is a change destination candidate can accommodate the track change target train at each future time from the current time.

[0056] The track change propriety determination processing unit 1240 reads the track length of the change destination candidate platform defined in the track data table 1130 and the train length of the train that has stopped at the change destination candidate platform at each time or is predicted to stop on the predicted schedule (S301) and calculates, a marginal space length, a value obtained by further subtracting the minimum inter-train distance from the difference between the track length and the train length (S302).

[0057] When the marginal space length has a value equal to or larger than the train length of the track change target train defined in the train data table, it is set that the track change target train can be accommodated in the platform which is the change destination candidate (S303 and S304).

[0058] When the marginal space length has a value equal to or smaller than the train length of the track change target train defined in the train data table, it is set that the track change target train cannot be accommodated in the platform as the change destination candidate (S303 and S305).

[0059] Furthermore, in a case where there exists another train that has stopped already among the platforms that cannot accommodate (S306), it is set that the platform cannot accommodate until the time at which the minimum departure waiting time interval is added to the departure time of the train (S307).

[0060] The minimum inter-train distance indicates the distance to be maintained between the trains and is assumed to be 10 m in this example.

[0061] The minimum departure waiting time interval denotes, in a platform for which a departure time cannot be defined within a certain period of time immediately after departure of another train which has already stopped or is predicted to stop or a platform which cannot to accommodate with no marginal space length, the time when it is not possible to define the schedule with the arrival time within a certain period of time immediately after departure of another train which has already stopped or is predicted to stop. In this example, the minimum departure waiting time interval is assumed to be 1 minute.

[0062] Next, the information display unit 1250 is activated (S308).

[0063] With respect to the platform/time determined to be able to accommodate the track change target train by the track change propriety determination processing unit 1240, in a case where there exists no train that has already stopped or no train that is predicted to stop on the predicted schedule the information display unit 1250 displays the platform/time determined to be able to accommodate the track change target train on the output device 1400 with a dot-patterned rectangle 251.

[0064] With respect to the platform/time determined to

be able to accommodate the track change target train by the track change propriety determination processing unit 1240, in a case where there exists a train that has already stopped or a train that is predicted to stop on the predicted schedule the information display unit 1250 displays the platform/time determined to be able to accommodate the track change target train on the output device 1400 with a mesh-patterned rectangle 252.

[0065] With respect to the platform/time determined to be unable to accommodate the track change target train by the track change propriety determination processing unit 1240 the information display unit 1250 displays the platform/time determined to be unable to accommodate the track change target train on the output device 1400 with a slanted-line-patterned rectangle 253.

[0066] At this time, the quadrangles illustrated above are displayed with different color shapes or colors or different colors and shapes so as to be distinguishable from each other. In this example, the quadrangles are identified by different shapes.

[0067] In addition, the information display unit 1250 may perform highlight indication for the platform/time determined that the track change target train can be accommodated by the track change propriety determination processing unit 1240.

[0068] With respect to the platform/time determined that the train can be accommodated, by distinguishing the indication depending on the presence or absence of a train, it is possible to improve the operability of the operator.

[0069] The information display unit displays the train so that the user can identify that the train can be accommodated in the change destination candidate platform or cannot be accommodated.

[0070] In the input device 1300, when the user drags a predicted schedule stripe of the train by mouse manipulation and drops the predicted schedule stripe to the platform/time which is determined to be track-changeable, the operation arrangement unit 1230 determines that the track change is performed on the platform to which the dragged train has been dropped and generates a provisional schedule obtained as a result of the track change.

[0071] For the provisional schedule to be generated, the platform dropped on the arrival destination platform of the train is set. For the arrival time of the train, the time at the position of the mouse pointer is set. For the departure time of the train, the time obtained by adding, to the arrival time, the stop time which is the difference between the departure time and the arrival time on the planned schedule of the track change target train is set. However, in a case where there exists the other train that has already stopped and the train cannot depart at the set departure time, for the departure time, the time obtained by adding the minimum departure waiting time interval to the predicted departure time of the other train is set. The provisional schedule generated above is written in the provisional schedule data table.

[0072] For example, when the user drags the predicted schedule stripe of the train by mouse manipulation using the input device 1300, the operation arrangement unit 1230 transmits, to the information display unit 1250, an instruction to display, under each platform name, the marginal space length obtained by subtracting the minimum inter-train distance from the difference between the train length of the stopped train of each platform at the time located on the mouse pointer 243 and the track length of each platform. The information display unit 1250 displays the marginal space length (231 to 232) corresponding to the track length of each platform under each platform name on the output device 1400.

[0073] The information display unit 1250 displays the schedule stripe 271 of the provisional schedule data table on the output device 1400. When the user allows the track change target train to enter the change destination candidate platform, even in a case where the change destination platform is in the transient state, the information display unit 1250 display the schedule stripe of the provisional schedule data table on the output device 1400. The transient state denotes that the total value of the train length of the train that has already existed in the change destination candidate platform or the train that is predicted to exist and the train length of the track change target train is larger than the track length of the change destination platform. That is, it is the case that the track change target train cannot be accommodated in the change destination platform. As a result, even in a case where the user mistakenly intends to allow the track change target train to enter the change destination platform which cannot accommodate, the change destination platform can be newly selected as the continuation. Therefore, the operability of the user is improved.

[0074] For example, when the user drops the predicted schedule stripe of the train to the platform/time which is determined to be track-changeable from the state where the user drags the predicted schedule stripe of the train by mouse manipulation using the input device 1300, the operation arrangement unit 1230 transmits an instruction to display the operation arrangement execution dialog for selecting operation arrangement execution/cancellation in the display instruction table to the information display unit 1250, and the information display unit 1250 displays the operation arrangement execute/cancel dialog 261 on the output device 1400. At this time, a schedule stripe as a provisional schedule is displayed on the output device.

[0075] For example, when the user clicks the execute button on the operation arrangement execution dialog by mouse manipulation using the input device 1300, the operation arrangement unit 1230 overwrites the provisional schedule of the operation arrangement target train of the schedule data table 1110 on the planned schedule of the operation arrangement target train.

[0076] When the user clicks the cancel button on the operation arrangement execution dialog by mouse manipulation using the input device 1300, the operation ar-

rangement unit 1230 deletes the provisional schedule of the operation arrangement target train from the provisional schedule data table.

[0077] Although the embodiments of the invention has been described above, an example in which the track change is performed on the train B will be described below.

[0078] Herein, the track length of Platform 1 is set to 80 m, the track length of Platform 2 is set to 100 m, and the track length of Platform 3 is set to 100 m.

[0079] First, the user picks the predicted schedule stripe of the train B by mouse manipulation. At this time, the operation arrangement unit 1230 executes the track change propriety determination processing unit 1240, and the track change propriety determination processing unit 1240 performs track change propriety determination on Platform 1, 2, and 3 which are the track change destination candidates.

[0080] In the process of the track change propriety determination processing unit 1240, at Platform 1, since the train length of the train A which is predicted to stop becomes 80 m at 12:03 from the current time 12:00 the marginal space length becomes 0 m obtained by subtracting 80 m which is the train length of the train A from 80 m which is the track length of Platform 1, so that the train B with a train length of 50 m cannot be accommodated.

[0081] At Platform 1, at the time after 12:04, since there exists no train which is predicted to stop, 80 m of the track length of Platform 1 becomes the marginal space length and the train B with a train length of 50 m can be accommodated.

[0082] At Platform 2, at the time of 12:04 from 12:00 which is the current time, since there exists the train C that has already stopped and the train length of the train C is 30 m, the marginal space length becomes 60 m obtained by subtracting 10 m which is the minimum inter-train distance from 70 m obtained by subtracting 30 m from 100 m which is the track length of Platform 2, so that the train B with a train length of 50 m can be accommodated.

[0083] At the time after 12:04, since there exists no train which is predicted to stop, the marginal space length becomes 100 m which is the track length of Platform 2 so that the train B with a train length of 50 m can be accommodated.

[0084] At Platform 3, at the time of 12:10 from 12:00 which is the current time, since there exists the train D that has already stopped and the train length of the train D is 50 m, the marginal space length becomes 40 m obtained by subtracting 10 m which is the minimum inter-train distance from 50 m obtained by subtracting 50 m from 100 m which is the track length of Platform 3, so that the train B with a train length of 50 m cannot be accommodated.

[0085] At the time after 12:10, since there exists no train which is predicted to stop, the marginal space length becomes 100 m which is the track length of Platform 3

so that the train B with a train length of 50 m can be accommodated.

[0086] Next, in the state where the user picks the predicted stripe of the train B by mouse manipulation, the user drags the predicted stripe to the point of Platform 2/12:00 which is determined to be track-changeable. At this time, a provisional schedule where 12:00 is set as the departure time and 12:06 which is 6 minutes after the stop time on the planned schedule of the train B as the arrival time is written in the provisional schedule data table by the operation arrangement unit 1230. In addition, the information display unit 1250 displays the provisional schedule stripe 271 of the train B on the output device 1400.

[0087] In addition, when the mouse pointer is located at 12:00, the operation arrangement unit 1230 calculates the marginal space length of each platform at 12:00 the operation arrangement unit 1230 transmits an instruction to display the marginal space length to the information display unit 1250, and the information display unit 1250 displays the marginal space length (231 to 233) on the output device 1400.

[0088] Herein, the marginal space length of Platform 1 at 12:00 which is the arrival time of the track change target train to the change destination candidate platform becomes 0 m which is the value obtained by subtracting 80 m which is the train length of the train A from 80 m which is the track length of Platform 1 the marginal space length of Platform 2 becomes 60 m which is the value obtained by subtracting 10 m which is the minimum inter-train distance from 70 m which is the value obtained by subtracting 30 m which is the train length of the train C from 100 m which is the track length of Platform 2, and the marginal space length of Platform 3 becomes 40 m which is the value obtained by subtracting 10 m which is the minimum inter-train distance from 50 m which is the value obtained by subtracting 50 m which is the train length of the train D from 100 m which is the track length of Platform 3.

[0089] Next, the user drops from the mouse pointer 241 of the predicted stripe of the train B to the mouse pointer 243 at the position of Platform 2/12:00 by mouse manipulation. At this time, the operation arrangement unit 1230 transmits an instruction to display the operation arrangement execution dialog for selecting execution/cancellation of the operation arrangement to the information display unit 1250, and the information display unit 1250 displays an operation arrangement execute/cancel dialog 261 on the output device 1400.

[0090] Next, the user clicks the execute button of the operation arrangement execution dialog. At this time, the screen display is switched from the upper diagram to the lower diagram of Fig. 12.

[0091] The operation arrangement unit 1230 writes the provisional schedule of the train B as the planned schedule of the train B, and the information display unit 1250 displays the planned schedule stripe and the predicted schedule stripe (281) of the train B. At this time, due to

the operation arrangement, the provisional schedule is written as the planned schedule, so that the planned schedule and the predicted schedule are coincident with each other. As a result, the operation arrangement of the train B is completed.

Second example

[0092] An example of manipulation of manual operation arrangement in a screen example 2 by train block shape according to this embodiment is illustrated. The same components as those of the first example will be omitted.

[0093] Fig. 11 illustrates the screen example 2 of the output device 1400 before the execution of operation arrangement in this embodiment.

[0094] The screen example 2 is a train position display/operation form in the operation arrangement support system according to the present invention and can be implemented with the same configuration as the system configuration in this embodiment, and the screen example is displayed on the output device 1400. The left side 302 on the screen plane 301 represents the station name and each platform in the station. The display (303 and 304) of the current time is displayed in the same manner as the screen example 1.

[0095] In this embodiment, on the screen plane 301, the schedule data table 1110 for each train is represented by a train block shape (311, 312, 321, 322, 323, and 324) imitating a train.

[0096] The information display unit 1250 acquires the predicted schedule 1113 of the schedule data table 1110 and displays the predicted train block shape (321, 322, 323, and 324) of each train on the screen.

[0097] The information display unit 1250 acquires the planned schedule 1111 of the schedule data table 1110 and displays the planned train block shape (311 and 312) of each train on the screen so as to be distinguishable from the predicted train block shape. More specifically, the planned train block shape is subjected to transparent treatment and displayed on the screen.

[0098] The information display unit 1250 displays the leading end of the train block shape on the side with the oblique cut among the schedule stripes of each train of the schedule data table 1110 so as to be the departure time of the platform on the schedule and displays the trailing end of the train block shape on the side with no oblique cut so as to be the arrival time of the platform on the schedule. In other words, the side with the oblique cut in the train block shape indicates the traveling direction of the train, and the traveling direction of the train is the rightward direction.

[0099] The information display unit 1250 acquires the train length of each train from the train data table 1120 for all the trains of the schedule data table 1110 and displays the train length on the screen so that the vertical axis of the train block shape becomes the acquired train length.

[0100] The information display unit 1250 acquires the train name of the train corresponding to each train block shape from the train data table 1120 for all trains of the schedule data table 1110 and displays the train name on each train block shape.

[0101] On the screen, the platform is represented by a rectangular platform block shape (331, 332, and 333).

[0102] The information display unit 1250 acquires the track length of each platform from the track data table 1130 and displays the track length on the screen so that the vertical axis of the platform block shape (331, 332, and 333) becomes the acquired track length.

[0103] On the screen, the horizontal axis of the platform block shape indicates the time.

[0104] In a case where a plurality of trains stop at the same platform at the same time, the information display unit 1250 displays the trains having faster departure time sequentially from the upper side to the lower side of the platform block shape on the screen.

[0105] Hereinafter, an example of displaying the screen example 2 in this example will be described.

[0106] The information display unit 1250 acquires each schedule of the train A, train B, train C, and train D defined in the planned schedule 1111 and the predicted schedule 1113 of the schedule data table 1110.

[0107] Since the planned schedule of the train A becomes a schedule where the train arrives at Platform 1 at 11:54 and departs from Platform 1 at 11:58, in the platform block shape of Platform 1 the train block shape 311 indicating the train A on the planned schedule from 11:54 to 11:58 is displayed on the screen.

[0108] Since the planned schedule of the train B becomes a schedule where the train arrives at Platform 1 at 12:00 and departs from Platform 1 at 12:06, in the platform block shape of Platform 1 the train block shape 312 indicating the train B on the planned schedule from 12:00 to 12:06 is displayed on the screen.

[0109] Since the planned schedule of the train C becomes a schedule where the train arrives at Platform 2 at 11:52 and departs from Platform 2 at 12:04, in the platform block shape of Platform 2 the train block shape 323 indicating the train C on the planned schedule from 11:52 to 12:04 is displayed on the screen.

[0110] Since the planned schedule of the train D becomes a schedule where the train arrives at Platform 3 at 11:45 and departs from Platform 2 at 12:04, in the platform block shape of Platform 2, the train block shape 324 indicating the train D on the planned schedule from 11:52 to 12:10 is displayed on the screen.

[0111] Since the predicted schedule of the train A becomes a schedule where the train arrives at Platform 1 at 11:58 and departs from Platform 1 at 12:02, in the platform block shape of Platform 1, the train block shape 321 indicating the train A on the predicted schedule from 11:58 to 12:02 is displayed on the screen.

[0112] Since the predicted schedule of the train B becomes a schedule where the train arrives at Platform 1 at 12:03 and departs from Platform 1 at 12:09, in the

platform block shape of Platform 1, the train block shape 322 indicating the train B on the predicted schedule from the time of 12:03 to 12:09 is displayed on the screen.

[0113] Since the planned schedule and the predicted schedule of the train C and the train D are coincident with each other, the train block shapes (323 and 324) are displayed to be superimposed.

[0114] As described above, in the screen example 2, since the vertical axis represents the track length of each platform and the train length of each train, and the horizontal axis represents the time, so that the visibility of the marginal space length at each platform and each time is improved, and it can be expected to simplify the operation arrangement task.

[0115] Furthermore, in order not to superimpose each train block shape, a train with a faster departure time is displayed on the screen sequentially from the upper side of the platform block shape downward. As a result, even in a case where there are trains that stop on the same platform at the same time, since the trains are displayed above and below the platform range, the visibility of the travel condition of each train can also be improved.

[0116] Fig. 13 illustrates an example of manipulation of the manual operation arrangement in a screen example 2 according to this embodiment.

[0117] Similarly to Fig. 11, in the screen example 2 of this embodiment the screen plane 301, the screen left side 302, the current time display (303, 304), the train block shape (311, 312, 321, 322, 323, and 324) are illustrated.

[0118] On the screen, when the user sets the mouse pointer 341 in the predicted train block shape indicating the train of the predicted schedule (mouse over), the operation arrangement unit 1230 acquires the train length of the train of the predicted train block shape which is in the "mouse over" state, from the train data table 1120, and transmits an instruction to display the acquired train length to the information display unit 1250, and the information display unit 1250 displays the train length 342 on the screen.

[0119] On the screen, when the user keeps clicking (picking) the predicted train block shape for which actual schedule of arrival to the platform defined as the departure platform has not been generated in the schedule data table 1110 by mouse manipulation, the operation arrangement unit 1230 determines that the picked train is a track change target and executes the track change propriety determination processing unit 1240. The track change propriety determination processing unit 1240 performs track change propriety determination on the platform/time which is the track change destination candidate of the picked train. The track change propriety determination is the same as the track change propriety determination in the embodiment illustrated in Fig. 8.

[0120] The cases (351 and 352) where the presence/absence of a train is displayed to be distinguishable for the platform/time determined to be able to accommodate the track change target trains (351 and 352) by the

track change propriety determination processing unit 1240 and the case (353) where the platform/time determined to be unable to accommodate the track change target train is displayed are the same as a case where the operation arrangement unit 1230 in the embodiment illustrated in Fig. 12 allows the information display unit 1250 to perform displaying.

[0121] In addition, the information display unit 1250 displays the minimum inter-train distance 100 as a rectangle 3300 illustrated in Fig. 13.

[0122] For example when the user drags the predicted train block shape to the platform/time determined to be changeable from the state where the user picks the predicted train block shape by mouse manipulation using the input device 1300, the operation arrangement unit 1230 determines that the dragged train is to be track-changed to the drug destination platform and generates a provisional schedule that is obtained as a result of track change. The provisional schedule is the same as the provisional schedule generated the provisional schedule generation method described with reference to Fig. 12.

[0123] For example, when the user drags the predicted train block shape 322 from the mouse pointer 341 to the mouse pointer 343 by mouse manipulation using the input device 1300, the method of displaying the marginal space length (331, 332, and 333) and the train block shape 371 of the provisional schedule to the output device 1400 is the same as the method described with reference to Fig. 12.

[0124] For example, when the user drops the predicted train block shape to the platform/time which is determined to be track-changeable from the state where the user drags the predicted train block shape by the mouse manipulation using the input device 1300, the method of displaying the operation arrangement execute/cancel dialog 361 on the output device 1400 and the process after inputting the operation arrangement cancellation/cancellation are the same as the method explained in Fig. 12.

[0125] The user clicks the execute button of the operation arrangement execution dialog. At this time, the screen display is switched from the upper diagram of Fig. 13 to the lower diagram.

[0126] The operation arrangement unit 1230 writes the provisional schedule of the train B as the planned schedule of the train B, and the information display unit 1250 displays the planned train block shape and the predicted train block shape (381) of the train B. At this time, due to the operation arrangement, the provisional schedule is written as the planned schedule, so that the planned schedule and the predicted schedule are coincident with each other. As a result, the operation arrangement of the train B is completed.

Third example

[0127] Fig. 14 is a diagram illustrating an example of automatic operation arrangement based on schedule stripes in this embodiment.

[0128] In the screen example of this embodiment, the same components as those in Fig. 10 will be omitted. The schedule stripes (211, 212, 221, 222, 223, and 224) displayed in the screen example are the same as those in Fig. 10.

[0129] The prediction calculation unit 1210 executes the processes as described in Fig. 5 at a certain period.

[0130] Next, the operation arrangement proposal unit 1220 executes the processes as described in Fig. 6 at a certain period. Herein, in a case where there exists a train in which a difference equal to or larger than a certain time between the planned schedule and the predicted schedule, it is determined that the train is delayed, and the operation arrangement unit 1230 activates to generate an operation arrangement plan that the train is an operation arrangement target train.

[0131] The operation arrangement unit 1230 activates the track change propriety determination processing unit 1240.

[0132] The track change propriety determination processing unit 1240 determines whether or not the operation arrangement target train as a track change target train can be accommodated in each platform which is a change destination candidate.

[0133] As illustrated in Fig. 9, the track change propriety determination processing unit 1240 starts a track change search loop (S401).

[0134] In a case where the track change target train has arrived at the platform at the current time, the track change propriety determination processing unit 1240 determines that track change is disabled (S402 and S407).

[0135] In a case where the track change target train has not arrived at the platform, the track change propriety determination processing unit 1240 calculates, as the marginal space length, a value obtained by subtracting the train length of the train which has stopped at the change destination candidate platform at each time or is predicted to stop on the predicted schedule of the schedule data table 1110 from the track length of the platform to be the change destination candidate defined in the track data table 1130 at each time in the future from the current time and by further subtracting the minimum inter-train distance (S403 and S404).

[0136] When the marginal space length has a value equal to or larger than the train length of the track change target train, it is set that the track change target train can be accommodated in the platform which is the change destination candidate (S405 and S406).

[0137] When the marginal space length has a value smaller than the train length of the track change target train, it is set that the track change target train cannot be accommodated in the platform which is the change destination candidate (S405, S407).

[0138] The track change propriety determination processing unit 1240 sets the platform/time that can accommodate the track change target train as the departure platform/arrival time. In a case where there exists no other train that has stopped, the departure time is set to the

time obtained by adding the stop time on the planned schedule of the track change target train to the arrival time. In a case where there exists another train which has already stopped, when the time obtained by adding the minimum departure waiting time interval to the predicted departure time of the other train which has already stopped is later than the time obtained by adding the stop time on the planned schedule of the track change target train to the arrival time the former time is set as the departure time. The provisional schedule of the track change target train is generated based on the arrival time and the departure time and is written in the provisional schedule data table of the schedule data table 1110 (S408).

[0139] The track change propriety determination processing unit 1240 activates the information display unit 1250 (S409) and ends the track change search loop (S410).

[0140] The operation arrangement unit 1230 acquires the provisional schedule data table of the schedule data table 1110 compares the provisional schedule of the track change target train with the predicted schedule of the track change target train deletes, from the provisional schedule data table, the provisional schedule of which the arrival time is to be later than the arrival time based on the predicted schedule of the track change target train.

[0141] After that, the operation arrangement unit 1230 compares the provisional schedule of the track change target train and the planned schedule of the track change target train and selects the provisional schedule of which departure time is closest to the planned schedule of the track change target train. The operation arrangement unit 1230 transmits a schedule stripe display instruction of the selected provisional schedule to the information display unit 1250. The information display unit 1250 displays the schedule stripe 471 of the provisional schedule on the output device 1400.

[0142] The subsequent processes are the same as those in the case of the manual operation arrangement described with reference to Fig. 12.

[0143] The operation arrangement unit 1230 transmits an instruction to display the operation arrangement execution dialog to the information display unit 1250, and the information display unit 1250 displays the operation arrangement execute/cancel dialog 261 on the output device 1400.

[0144] For example, when the user clicks the execute button on the operation arrangement execution dialog by mouse manipulation using the input device 1300, the operation arrangement unit 1230 overwrites the provisional schedule of the operation arrangement target train of the schedule data table 1110 on the planned schedule of the operation arrangement target train. At this time, the screen display is switched to the lower diagram, and the output device displays a schedule stripe 481 which is set as a provisional schedule.

[0145] When the user clicks the execute button on the operation arrangement execute/cancel dialog 261 by

mouse manipulation using the input device 1300, the operation arrangement unit 1230 overwrites the provisional schedule of the track change target train on the planned schedule of the operation arrangement target train.

[0146] When the user clicks the cancel button on the operation arrangement execute/cancel dialog 261 by mouse manipulation using the input device 1300, the operation arrangement unit 1230 deletes the provisional schedule of the track change target train from the provisional schedule data table.

[0147] Although the embodiments of the invention has been described above, an example in which automatic train arrangement is performed on the train B having a train length of 50 m will be described.

[0148] Herein, the track length of Platform 1 is set to 80 m, the track length of Platform 2 is set to 100 m, and the track length of Platform 3 is set to 100 m.

[0149] First, the operation arrangement proposal unit 1220 compares the planned schedule with the predicted schedule of the train A of the schedule data table 1110.

[0150] With respect to the planned schedule of the train A, the train A is planned to arrive at Platform 1 at 11:54 and to depart at 11:58.

[0151] With respect to the predicted schedule of the train A, the train A is predicted to arrive at Platform 1 at 11:58 and to depart at 12:02.

[0152] Herein, for the train A, since a difference of 4 minutes is generated between the planned schedule and the predicted schedule, the operation arrangement proposal unit 1220 activates the operation arrangement unit 1230 with the train A having a delay.

[0153] The operation arrangement unit 1230 activates the track change propriety determination processing unit 1240, and the track change propriety determination processing unit searches for the track change destination candidate of the train A by setting the train A as the track change target train. However, since the train A has already arrived at Platform 1 at the time of 12:00 which is the current time, there exists no track change destination, and the processes is ended.

[0154] Next, the operation arrangement proposal unit 1220 compares the planned schedule with the predicted schedule of the train B of the schedule data table 1110.

[0155] The planned schedule of the train B is planned to arrive at Platform 1 at 12:00 and to depart at 12:06.

[0156] The predicted schedule of the train B is predicted to arrive at Platform 1 at 12:03 and to depart at 12:09.

[0157] Herein, for the train B, since a difference of 3 minutes is generated between the planned schedule and the predicted schedule, the operation arrangement proposal unit 1220 activates the operation arrangement unit 1230 with the train B having a delay.

[0158] The operation arrangement unit 1230 activates the track change propriety determination processing unit 1240. The track change propriety determination processing unit 1240 determines whether or not the train B can be accommodated in Platform 1, Platform 2, and Platform 3 which are track change destination candidates.

[0159] The track change propriety determination processing unit 1240 determines whether or not the train B can be accommodated in the platform which is the change destination candidate at each future time from 12:00 which is the current time.

[0160] At Platform 1, since the train A stops from 12:00 to 12:02, the track length of Platform 1 is 80 m, and the train length of the train A is 80 m. Therefore, the marginal space length is 0 m, so that the train B cannot be accommodated in Platform 1 at this time.

[0161] At the time after 12:02, since there exists no train that has stopped and no train that is predicted to stop, the marginal space length is 80 m. Even if 50 m of the train length of the train B is subtracted from the marginal space length, there exists still a margin of 30 m, so that the train B can be accommodated in Platform 1 at this time.

[0162] The track change propriety determination processing unit 1240 generates a provisional schedule of the train B by setting the time after 12:02 of Platform 1 as the departure Platform/arrival time and setting sets the time obtained by adding 6 minutes which is the stop time on the planned schedule of the train B to the time after 12:02 as the departure time and writes the provisional schedule in the provisional schedule data table of the schedule data table 1110.

[0163] At Platform 2, the train C stops from 12:00 to 12:04, the track length of Platform 2 is 100 m, and the train length of the train C is 30 m. Therefore, the marginal space length is 60 m obtained by further subtracting 10 m which is the minimum inter-train distance from 70 m which is obtained by subtracting 30 m which is the train length of the train C from 100 m which is the track length of Platform 2. Even if 50 m of the train length of the train B is subtracted from the marginal space length, there exists still a margin of 10 m, so that the train B can be accommodated in Platform 2 at this time.

[0164] At the time after 12:04, since there exists no train that has stopped and no train that is predicted to stop, the marginal space length is 100 m. Even if 50 m of the train length of the train B is subtracted from the marginal space length, since there exists still a margin of 50 m, so that the train B can be accommodated in Platform 2 at this time.

[0165] The track change propriety determination processing unit 1240 sets the time after 12:00 of Platform 2 as the departure platform/arrival time. The track change propriety determination processing unit sets the time obtained by adding 6 minutes which is the stop time on the planned schedule of the train B to the time after 12:00 as the departure time. As a result, the track change propriety determination processing unit generates and writes a provisional schedule of the train B in the provisional schedule data table of the schedule data table 1110.

[0166] At Platform 3, the train D stops from 12:00 to 12:10, the track length of Platform 3 is 100 m, and the train length of the train D is 50 m. Therefore, the marginal

space length is 40 m obtained by further subtracting 10 m which is the minimum inter-train distance from 50 m which is obtained by subtracting 50 m which is the train length of the train D from 100 m which is the track length of Platform 3. The train B cannot be accommodated in Platform 1 at this time.

[0167] At the time after 12:10, since there are no train that has stopped and no train that is predicted to stop, the marginal space length is 100 m. Even if 50 m of the train length of the train B is subtracted from the marginal space length, there exists still a margin of 50 m, so that the train B can be accommodated in Platform 3 at this time.

[0168] The track change propriety determination processing unit 1240 sets the time after 12:10 of Platform 1 as the departure platform/arrival time. The track change propriety determination processing unit sets the time obtained by adding 6 minutes which is the stop time on the planned schedule of the train B to the time after 12:10 as the departure time. As a result, the track change propriety determination processing unit generates and writes a provisional schedule of the train B in the provisional schedule data table of the schedule data table 1110.

[0169] The operation arrangement unit 1230 acquires the provisional schedule data table of the schedule data table 1110 compares the provisional schedule of the train B with the predicted schedule of the train B, and deletes from the provisional schedule data table, the provisional schedule of which the arrival time is to be later than 12:03 which is the arrival time of the predicted schedule of the train B and departs to Platform 1 and Platform 3 and the provisional schedule of which the arrival time is a time after 12:03 of Platform 2.

[0170] After that, the operation arrangement unit 1230 compares the provisional schedule of the train B of the provisional schedule data table with the planned schedule of the train B and selects a provisional schedule where the train arrives at 12:00 at Platform 2 of which the departure time is closest to the planned schedule of the train B and departs from Platform 2 at 12:06.

[0171] The operation arrangement unit 1230 transmits a schedule stripe display instruction of the selected provisional schedule to the information display unit 1250. The information display unit 1250 displays the schedule stripe 471 of the provisional schedule on the output device 1400.

[0172] Next, the operation arrangement unit 1230 transmits to the information display unit 1250, an instruction to display an operation arrangement execution dialog asking whether or not it is necessary to perform the operation arrangement with the planned schedule of the track change target train as the selected provisional schedule. The information display unit 1250 displays the operation arrangement execute/cancel dialog 261 which asks whether or not it is necessary to perform the operation arrangement on the output device 1400.

[0173] If the user selects the execute button on the

operation arrangement execute/cancel dialog 261 by using the input device 1300, the operation arrangement unit 1230 overwrites the provisional schedule of the train B on the planned schedule 481 of the train B.

[0174] As described above, according to the embodiments and examples, it is possible to reduce delay time by entering the track change target train into the change destination candidate platform and by proposing track change by the operation arrangement support system. Therefore, it is possible to perform operation arrangement for delay recovery based on track change to the same platform in a case where travel delay of a train occurs. In addition, by automatically proposing the operation arrangement based on track change, it is possible to implement more efficient train travel.

[0175] In addition, the present invention is not limited to the above-described examples, but it includes various modified examples. For example, the above-described examples have been described in detail in order to explain the present invention in an easy-to-understand manner, and thus, the embodiments are not necessarily limited to those having all the configurations described. In addition, a portion of a configuration of one example can be replaced by a configuration of another example, and a configuration of another example can be added to a configuration of one example. In addition, a portion of a configuration of each example can be added with, deleted from, and replaced with other configurations. In addition, a portion or all of each of the above-described configurations, functions, processing units, processing means, and the like may be implemented by hardware by designing for example, integrated circuits or the like. In addition, each of the above-described configurations, processes, and the like may be implemented by software by interpreting and executing programs implementing the respective functions by a processor. Information of a program, a table, a file, and the like that implement each function can be stored in a recording device such as a memory a hard disk, or a solid state drive (SSD) or a recording medium such as an IC card, an SD card, or a DVD.

Claims

1. An operation arrangement support apparatus comprising:

travel management means acquiring an on-track position of a traveling train and an actual schedule indicating a travel record of the train; prediction calculation means calculating a predicted schedule indicating the operation prediction of the train from the on-track position; track change propriety determination means acquiring train length information of the train, track length information indicating a length of the platform as a candidate for arrival of the train, and

- train length information of another train that has stopped at the platform or is predicted to stop in the future based on the actual schedule and the predicted schedule, comparing the train length information of the train, the track length information, and the train length information of the other train, and determining a train occupancy situation of the platform; and
information display means displaying the train occupancy situation.
2. The operation arrangement support apparatus according to claim 1, further comprising operation arrangement means accepting a track change target train of which an arrival track is to be changed from the train,
wherein the track change propriety determination means searches for an arrival candidate platform of a change destination of the track change target train and determines a length of the platform at which the train that has stopped or is predicted to stop at the arrival candidate platform in the future is not on track as the train occupancy situation.
3. The operation arrangement support apparatus according to claim 2, wherein the operation arrangement means acquires a planned schedule indicating a planned travel situation of the train, determines the train to be a delayed train in a case where a difference between the planned schedule and the predicted schedule exceeds a specific value, and accepts the delayed train as a train of which the arrival track is to be changed.
4. The operation arrangement support apparatus according to claim 2,

wherein the track change propriety determination means compares the train length of the track change target train with the train occupancy situation to determine whether or not the track change target train can be accommodated in the platform, and
the information display means displays a result of the determination.
5. The operation arrangement support apparatus according to claim 4,

wherein, in a case where the platform is in a transient state when the track change target train enters the change destination candidate platform, the track change propriety determination means determines that the track change target train cannot enter the platform, and
the information display means displays on an output device that the track change target train is in an input transient state with respect to the
- change destination candidate platform.
6. The operation arrangement support apparatus according to claim 4,

wherein the track change propriety determination means determines a start time at which the track change target train can be in an on-track state on the change destination candidate platform based on the predicted schedule, and
the information display means displays the start time on an output device.
7. The operation arrangement support apparatus according to claim 2, wherein, in a case where a plurality of trains can be in an on-track state on the change destination candidate platform, the information display means display the change destination candidate platform in a highlight manner.
8. The operation arrangement support apparatus according to claim 2, further comprising proposal means allowing the track change target train to enter the change destination candidate platform and proposing the track change to reduce delay time.

FIG. 1

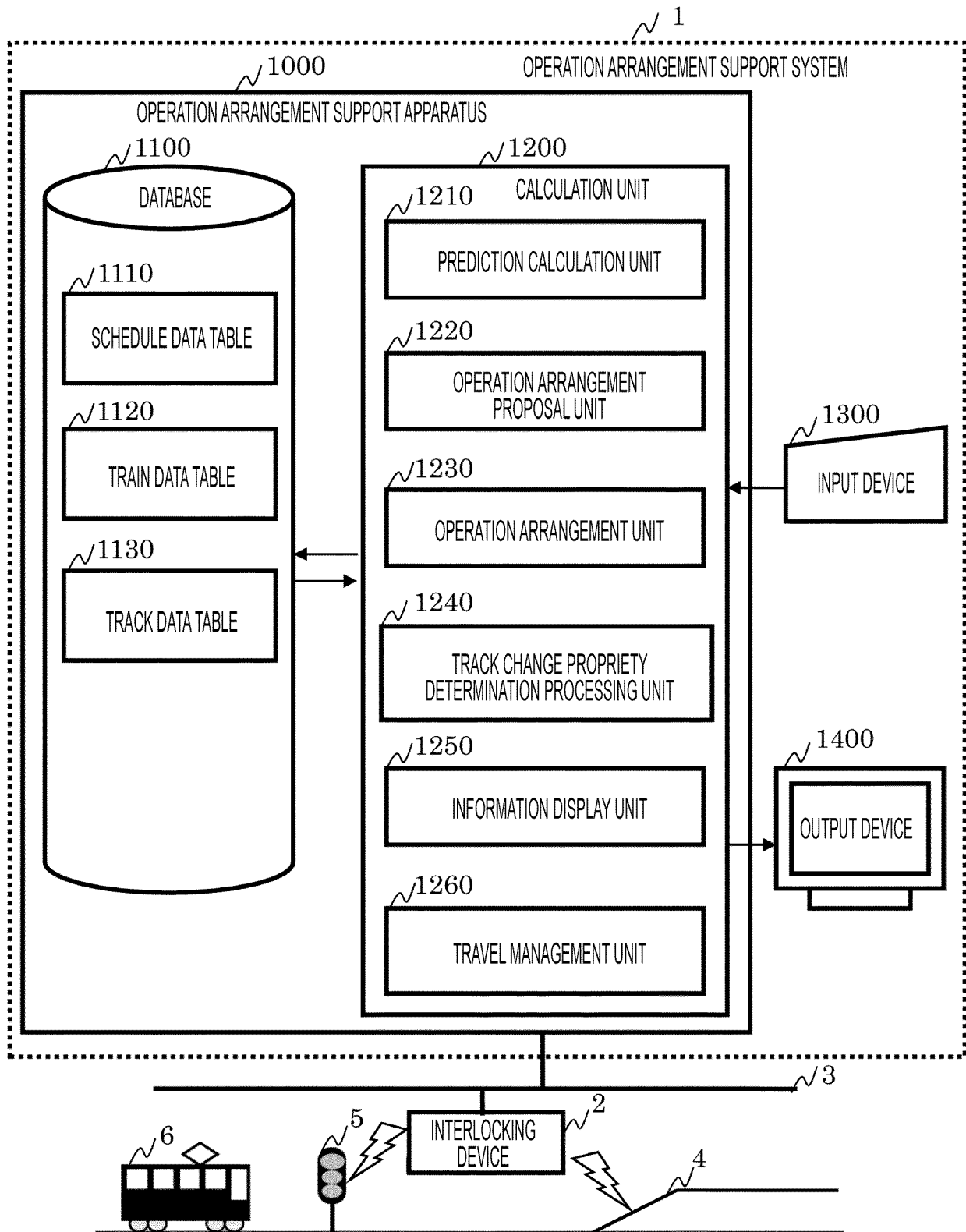


FIG. 2

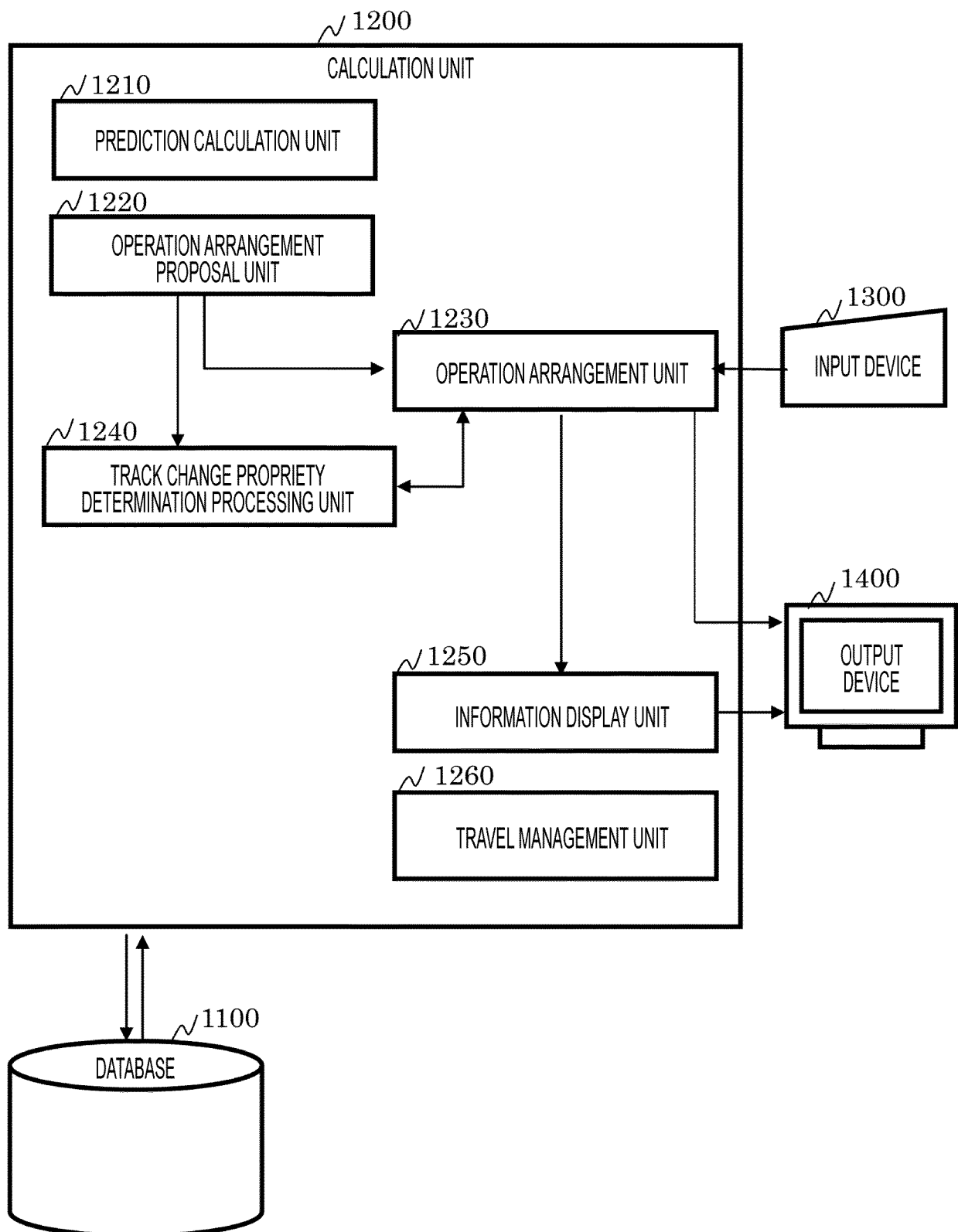


FIG. 3

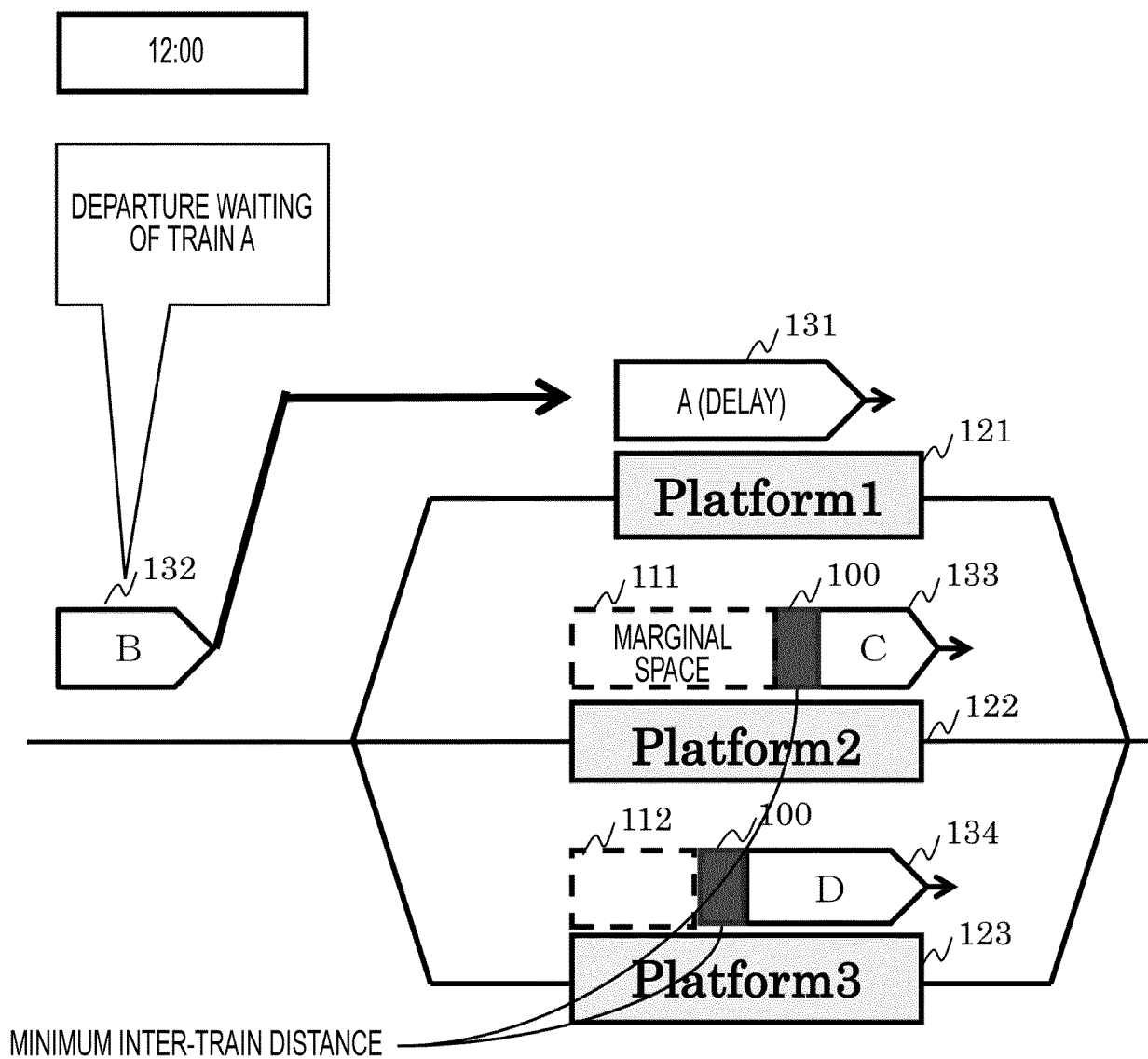


FIG. 4-1

PLANNED SCHEDULE ~1111			
TRAIN	ARRIVAL DEPARTURE P.F.	ARRIVAL TIME	DEPARTURE TIME
A	Platform1	11:54	11:58
B	Platform1	12:00	12:06
C	Platform2	11:52	12:04
D	Platform3	11:45	12:10

ACTUAL SCHEDULE ~1112			
TRAIN	ARRIVAL DEPARTURE P.F.	ARRIVAL TIME	DEPARTURE TIME
A	Platform1	11:58	—
B	Platform1	—	—
C	Platform2	11:52	—
D	Platform3	11:45	—

PREDICTED SCHEDULE (BEFORE OPERATION ARRANGEMENT) ~1113			
TRAIN	ARRIVAL DEPARTURE P.F.	ARRIVAL TIME	DEPARTURE TIME
A	Platform1	11:58	12:02
B	Platform1	12:03	12:09
C	Platform2	11:52	12:04
D	Platform3	11:45	12:10

PROVISIONAL SCHEDULE (BEFORE OPERATION ARRANGEMENT) ~1114			
TRAIN	ARRIVAL DEPARTURE P.F.	ARRIVAL TIME	DEPARTURE TIME
A	—	—	—
B	—	—	—
C	—	—	—
D	—	—	—

FIG. 4-2

TRAIN DATA

1120

TRAIN NAME	TRAIN LENGTH
A	80m
B	50m
C	30m
D	50m

FIG. 4-3

TRACK DATA	
~ 1130	
TRAIN NAME	TRAIN LENGTH
Platform1	80m
Platform2	100m
Platform3	100m

FIG. 5

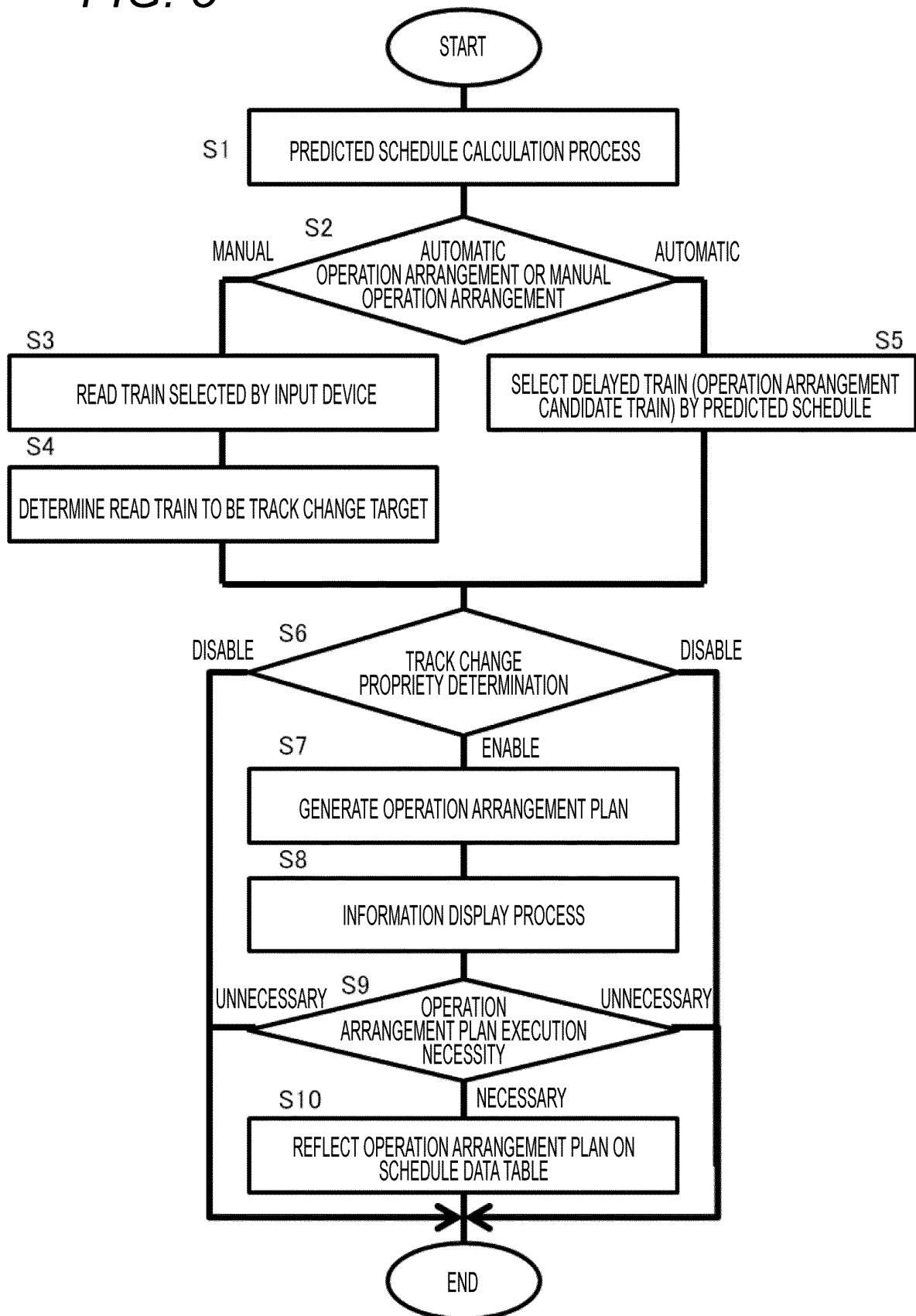


FIG. 6

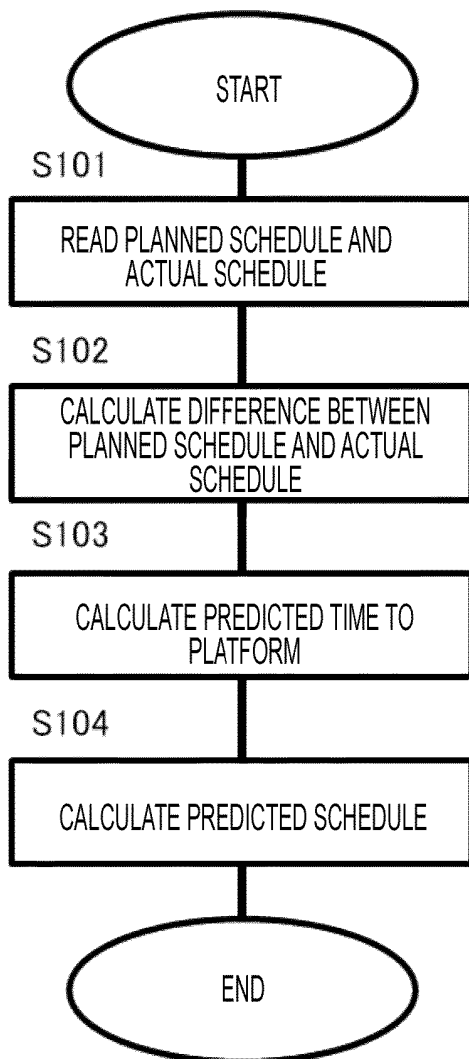


FIG. 7

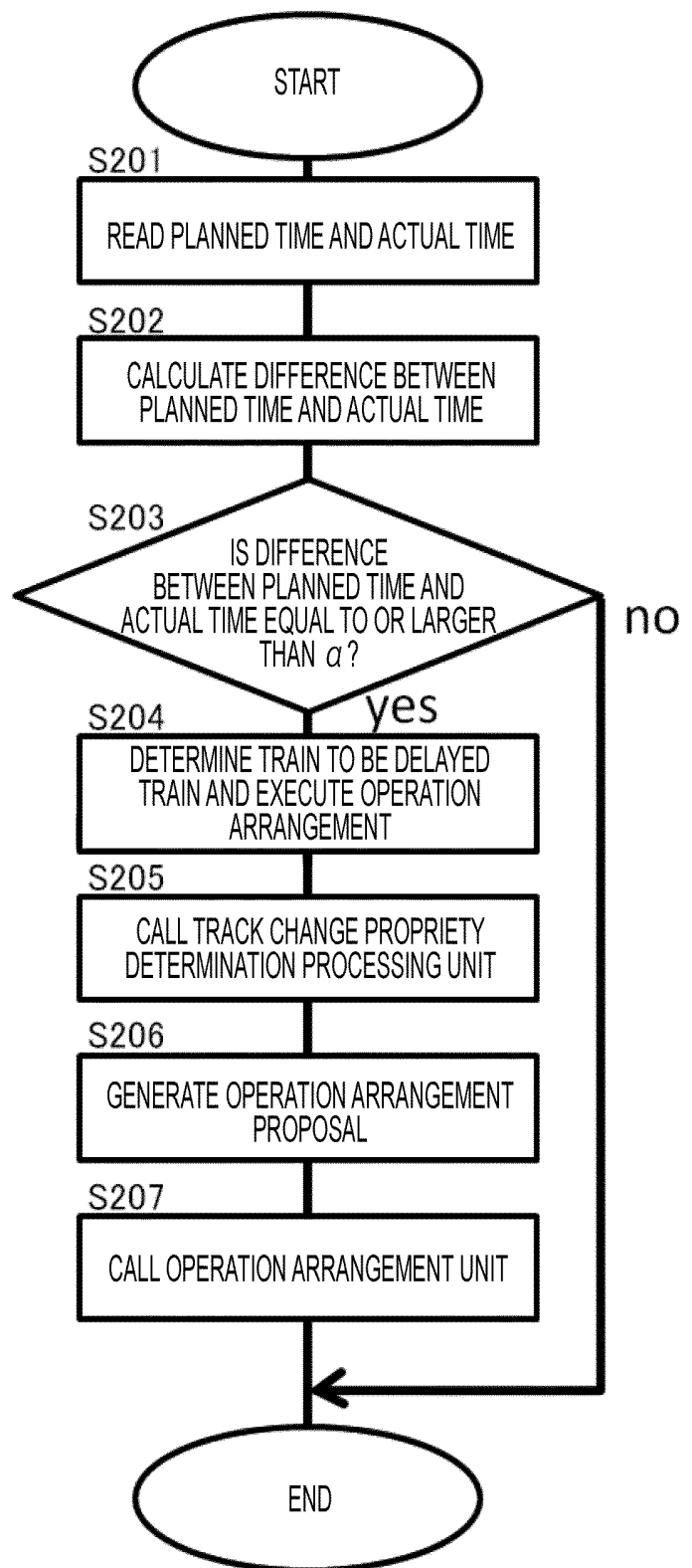


FIG. 8

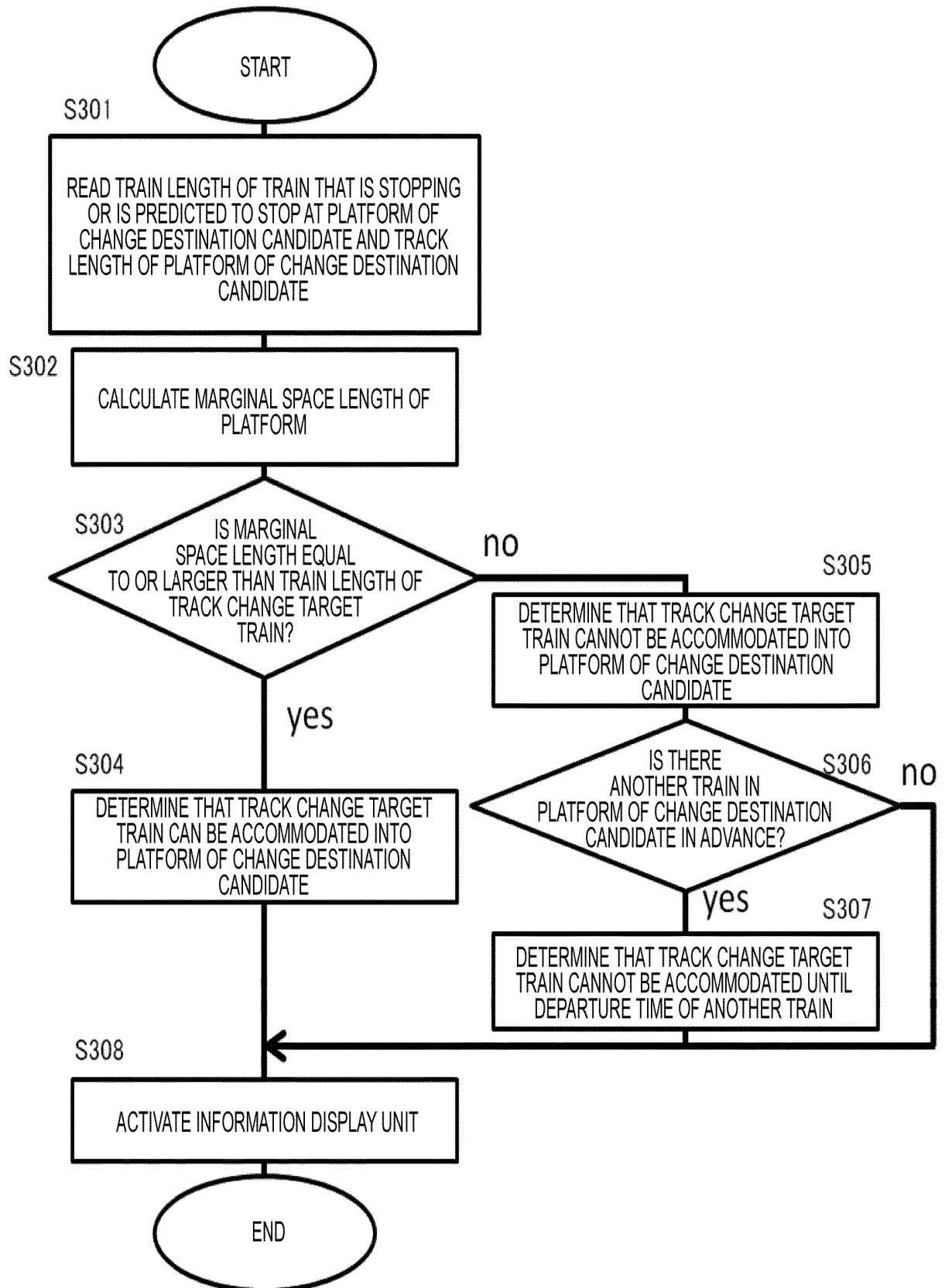


FIG. 9

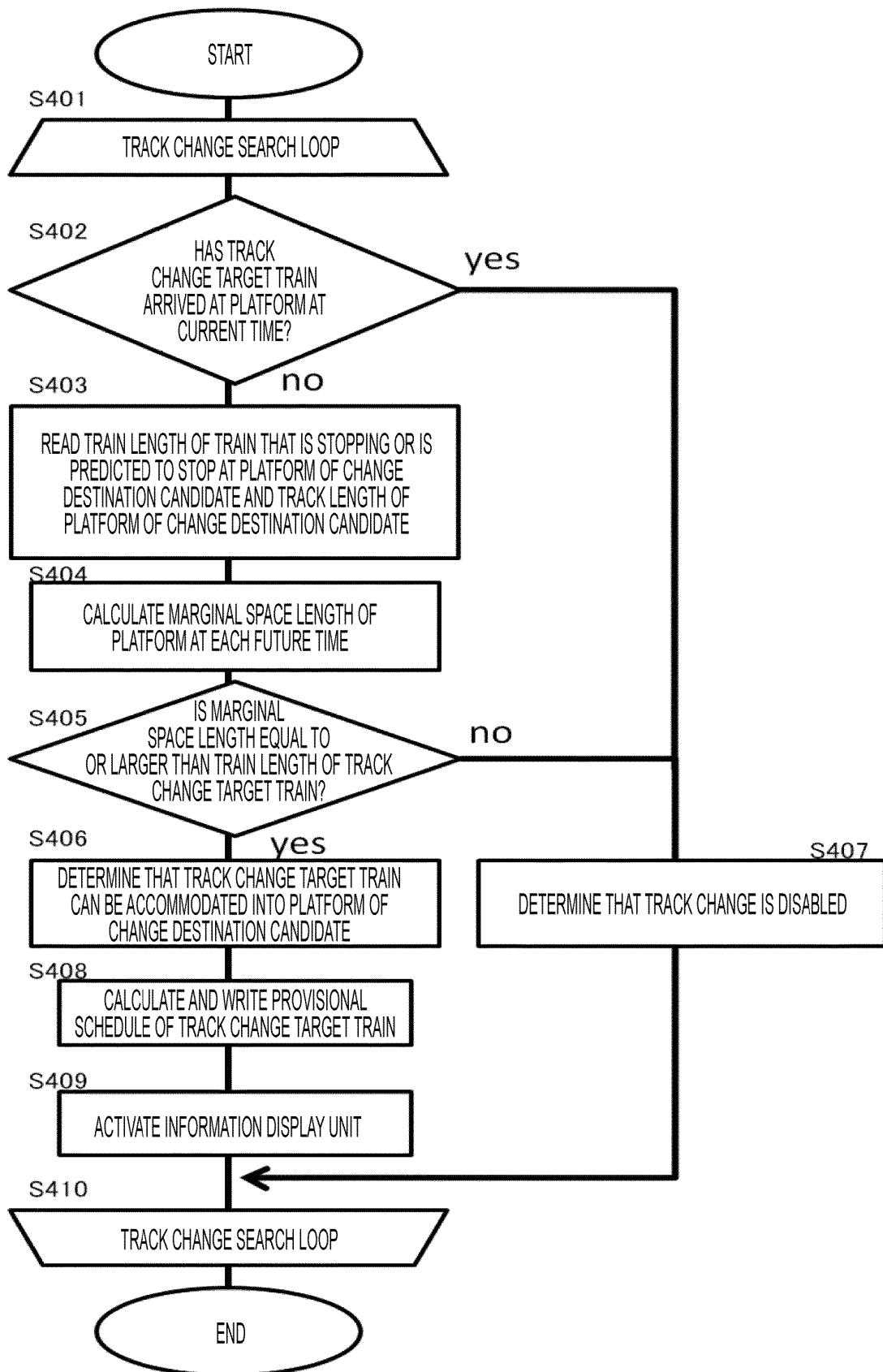


FIG. 10

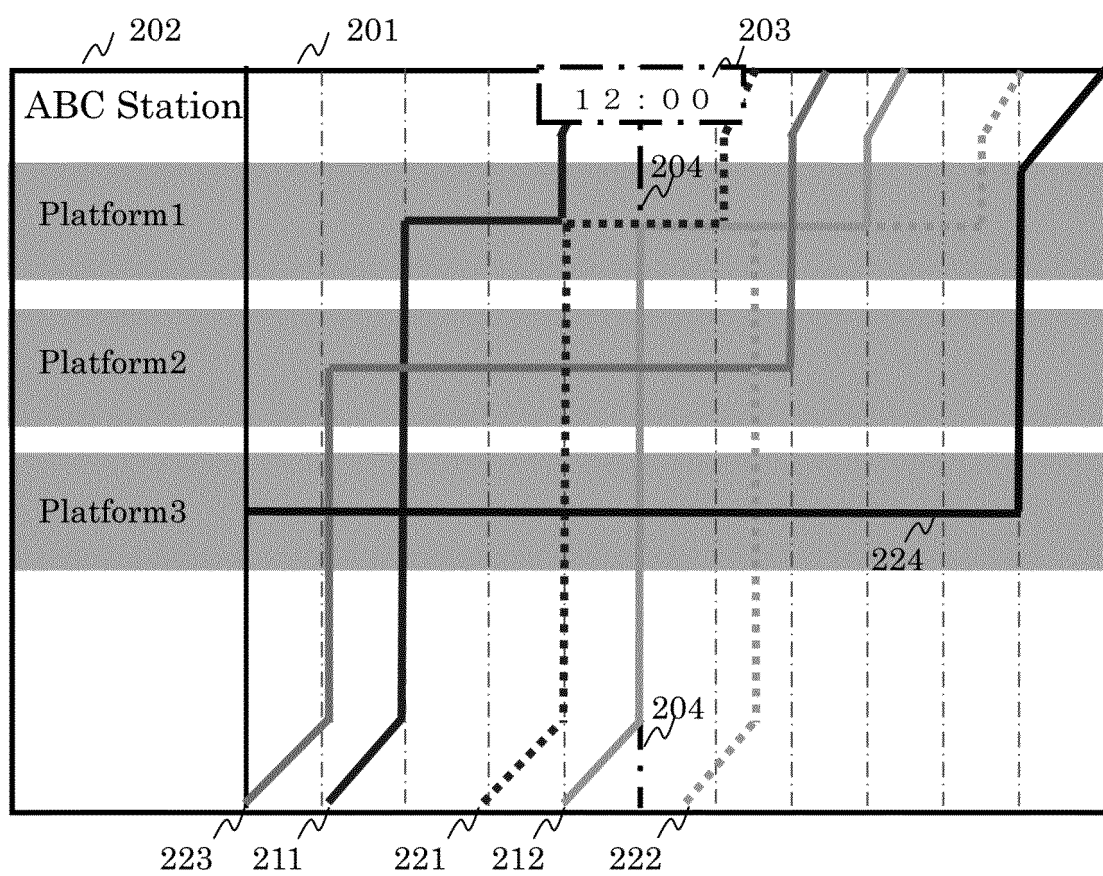


FIG. 11

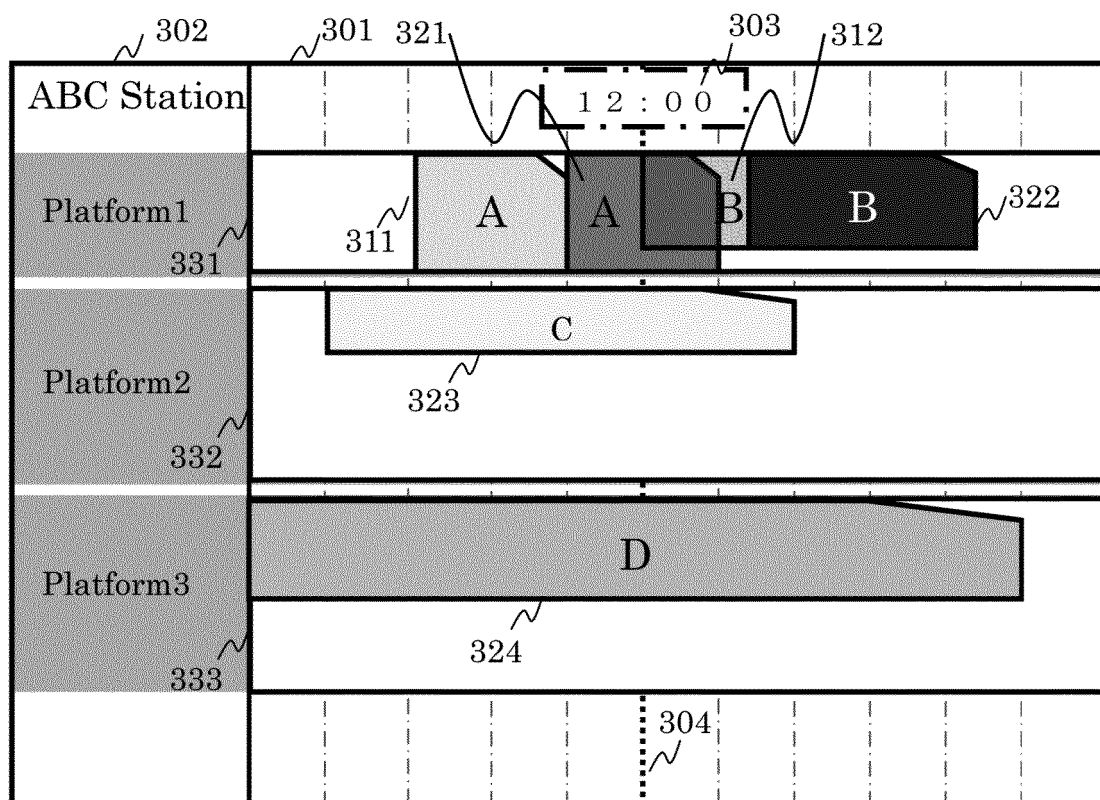


FIG. 12

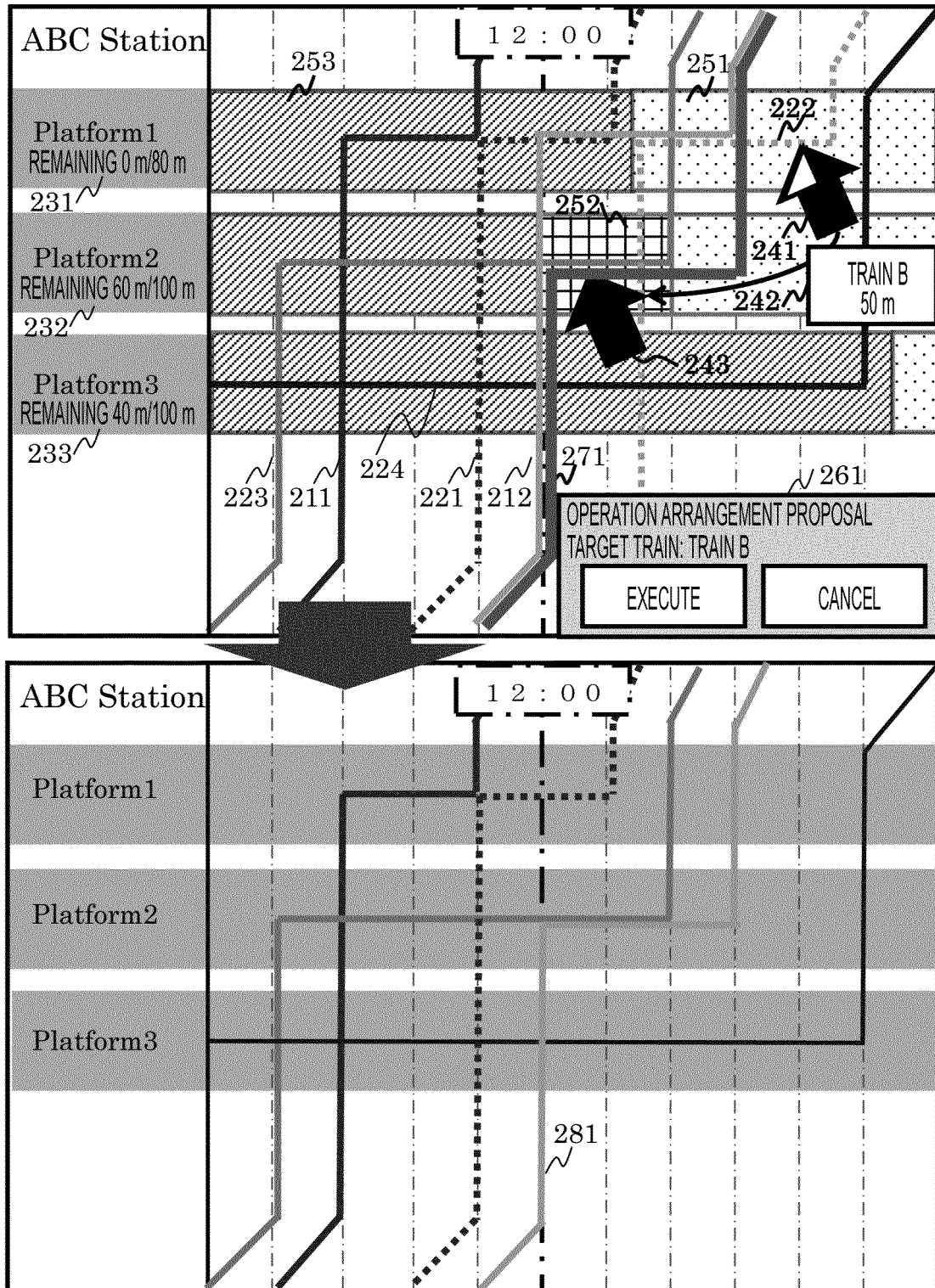


FIG. 13

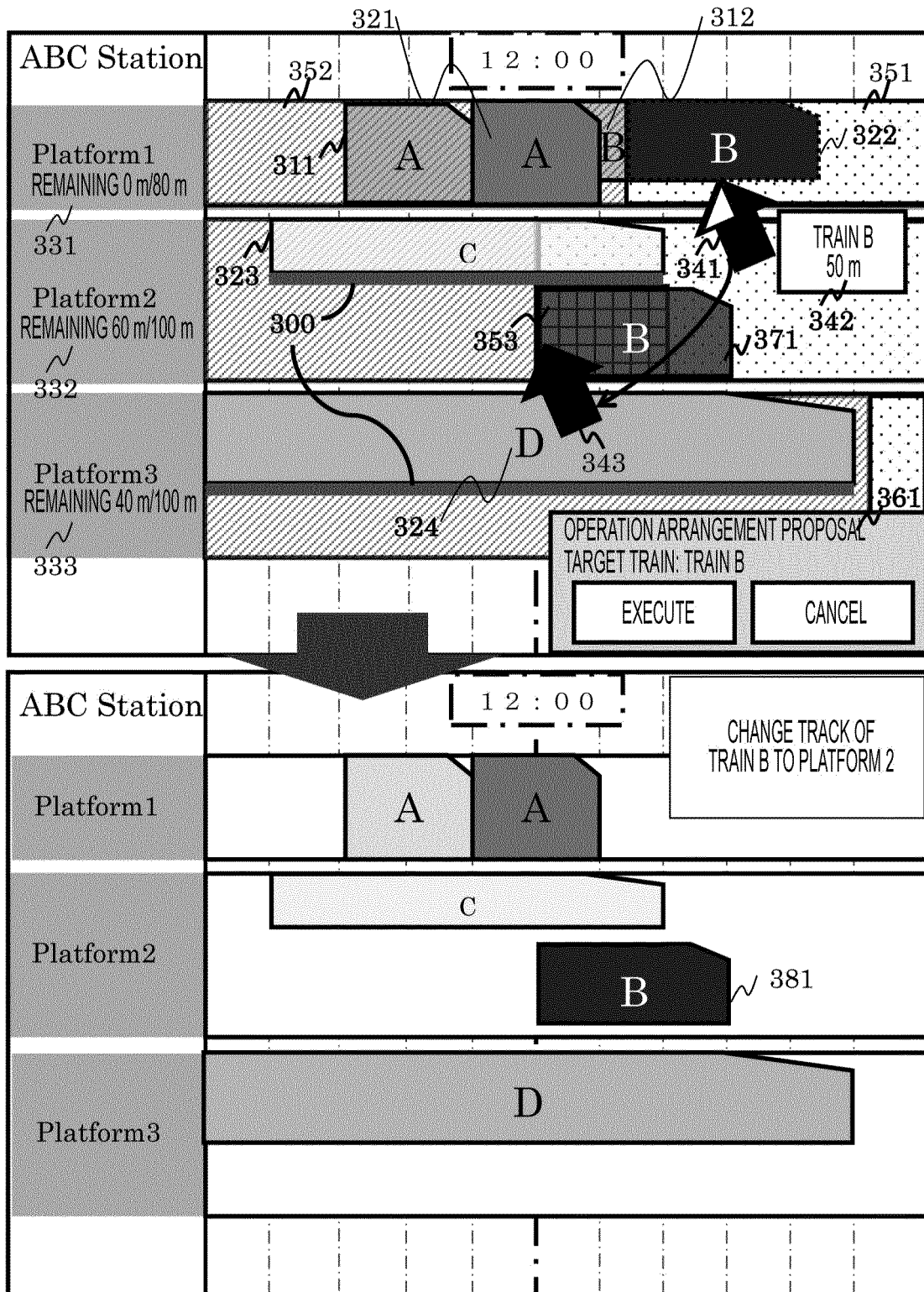
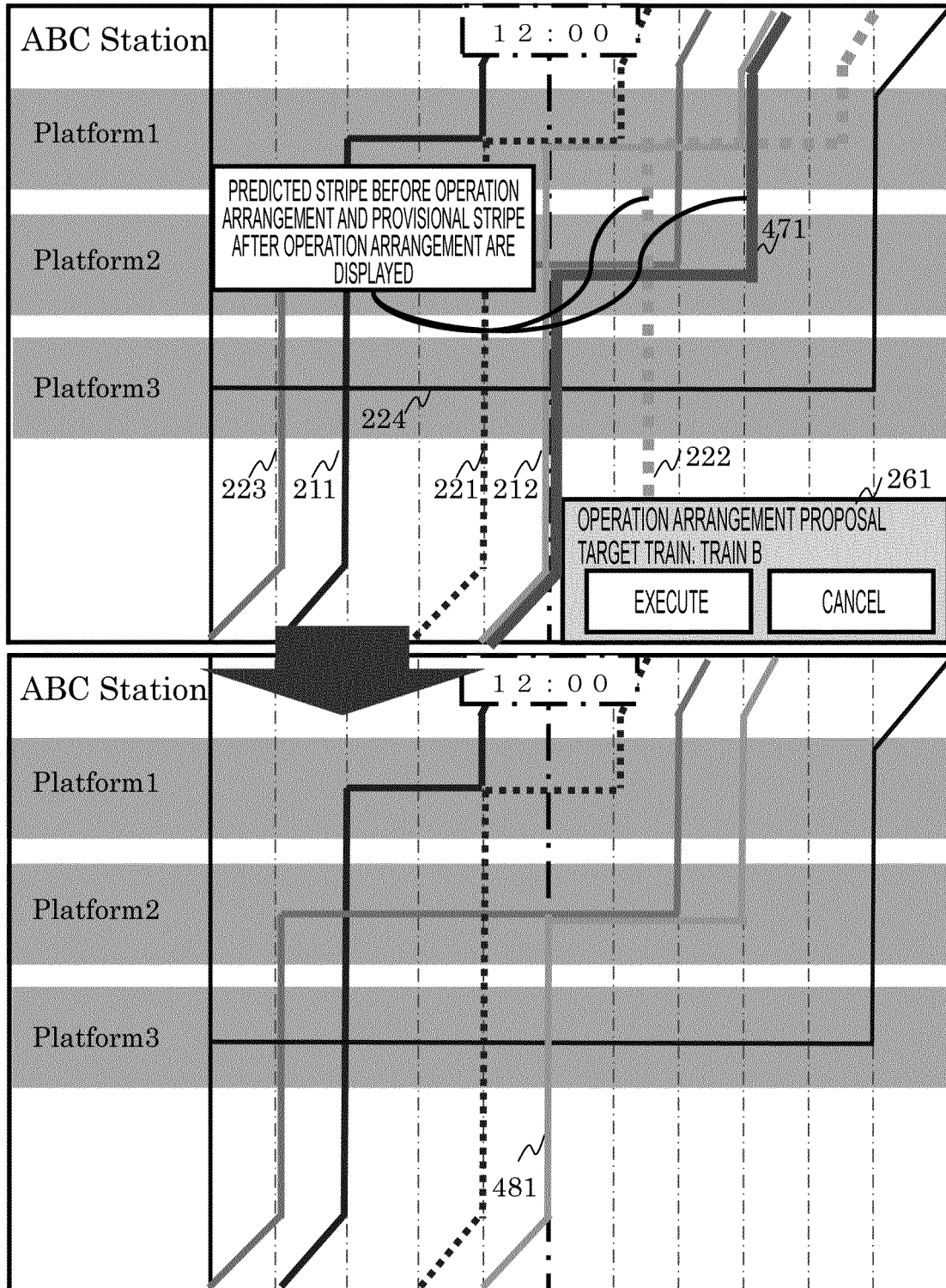


FIG. 14



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/076603

A. CLASSIFICATION OF SUBJECT MATTER

B61L27/00(2006.01)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)

B61L1/00-99/00

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 1996-2015
 Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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	WO 2014/064778 A1 (Hitachi, Ltd.), 01 May 2014 (01.05.2014), paragraphs [0013] to [0093]; fig. 1 to 14 & EP 2913244 A1 paragraphs [0014] to [0123]; fig. 1 to 14 & AU 2012393186 A	1-8
Y	JP 2013-136262 A (Mitsubishi Electric Corp.), 11 July 2013 (11.07.2013), paragraphs [0012] to [0035], [0072] to [0077]; fig. 1 to 6, 15 (Family: none)	1-8
Y	JP 2011-235681 A (Hitachi, Ltd.), 24 November 2011 (24.11.2011), paragraphs [0030] to [0045]; fig. 4 to 6 (Family: none)	7



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

02 December 2015 (02.12.15)

Date of mailing of the international search report

22 December 2015 (22.12.15)

Name and mailing address of the ISA/

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku,

Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/076603

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-40161 A (Hitachi, Ltd.), 06 March 2014 (06.03.2014), paragraphs [0011] to [0123]; fig. 1 to 14 & GB 2507163 A page 5, line 21 to page 39, line 8; fig. 1 to 14	1-8
A	JP 2014-91480 A (Hitachi, Ltd.), 19 May 2014 (19.05.2014), paragraphs [0010] to [0075]; fig. 1 to 8C & GB 2508508 A page 7, line 14 to page 35, line 2; fig. 1 to 8C	1-8
A	WO 2015/118701 A1 (Hitachi Systems, Ltd.), 13 August 2015 (13.08.2015), paragraphs [0056] to [0057]; fig. 16 to 17 (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

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 2008222004 A [0004] [0005]