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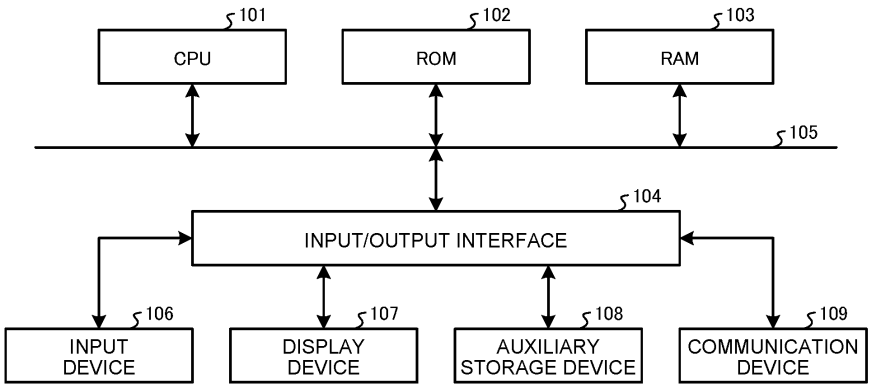
(54) **DEVICE FOR CREATING TRACK USE PLAN, AND METHOD FOR CREATING TRACK USE PLAN**

(57) A device for creating a track use plan of an embodiment includes a selector and an allocator. The selector selects a schedule line of a target train to which a track of a station is to be allocated out of a plurality of the schedule lines included in a schedule of the station. The allocator allocates, to the schedule line of the target train, the track according to a track condition indicating an attribute of a train allocatable to the track, and allocates, to the schedule line of the target train, the track having a shortest operation headway out of a plurality of the tracks on the basis of an operation headway on each track between the target train and a preceding train preceding the target train when the track cannot be allocated to the schedule line of the target train according to the track condition.

FIG.1



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Description

FIELD

[0001] Embodiments of the present invention relate to a device for creating a track use plan and a method for creating a track use plan.

BACKGROUND

[0002] Methods for allocating, to a train line, a track according to a preset rule, including a method for alternately allocating, to a train line, a plurality of tracks and a method for allocating, to a train line, a plurality of tracks according to a train classification, have been proposed.

CITATION LIST

Patent Literature

[0003] Patent Literature 1: Japanese Patent Application Laid-open No. H7-52801

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0004] Unfortunately, it is sometimes difficult to allocate a track to a train line according to a preset rule in overseas terminal stations with many tracks. To be more specific, in a terminal station with many tracks, a track allocating rule may be unclear due to there being many tracks, trains are often guided into tracks sequentially from an empty track, and a track on which a train arrives may be displayed in, for example, an electric bulletin board immediately before the arrival of the train.

[0005] Additionally, it is difficult to automatically create a track use plan for a station where trains on various line sections cross each other. For example, when trains of a plurality of companies run on the same line section, train operations are complicated. Thus, a turnaround at an intermediate station, an operation direction, a train classification, an operation classification, and a stopping station are diversified. This sometimes makes it difficult to automatically create a track use plan for a station other than the terminal station.

Means for Solving Problem

[0006] A device for creating a track use plan according to an embodiment includes a selector, and an allocator. The selector selects a schedule line of a target train to which a track of a station is to be allocated out of a plurality of the schedule lines included in a schedule of the station. The allocator allocates, to the schedule line of the target train, the track according to a track condition indicating an attribute of a train allocatable to the track, and allocates, to the schedule line of the target train, the track having a shortest operation headway out of a plurality of the tracks on the basis of an operation headway on each track between the target train and a preceding train preceding the target train when the track is not able to be allocated to the schedule line of the target train according to the track condition.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

FIG. 1 is a diagram illustrating an example of a hardware configuration of an information processing apparatus according to a first embodiment.
FIG. 2 is a block diagram illustrating an example of a functional configuration of the information processing apparatus according to the first embodiment.
FIG. 3 is a flowchart illustrating an example of a track allocation processing flow in the information processing apparatus according to the first embodiment.
FIG. 4 is a diagram illustrating an example of a railway network for which a schedule is created in the information processing apparatus according to the first embodiment.
FIG. 5 is a diagram illustrating an example of a schedule of a terminal station created by the information processing apparatus according to the first embodiment.

FIG. 6 is a diagram illustrating another example of the railway network for which a schedule is created in the information processing apparatus according to the first embodiment.
FIG. 7 is a diagram illustrating an example of a schedule of an intermediate station created by the information processing apparatus according to the first embodiment.
FIG. 8 is a diagram illustrating an example of the schedule created by the information processing apparatus according to the first embodiment.
FIG. 9 is a diagram illustrating examples of a track condition of a track allocated to a train in the information processing apparatus according to the first embodiment.
FIG. 10 is a diagram illustrating examples of an attribute of a succeeding train in the information processing apparatus according to the first embodiment.
FIG. 11 is a diagram illustrating examples of an operation headway between a succeeding train and a preceding train in the information processing apparatus according to the first embodiment.
FIG. 12 is a diagram illustrating a display example of the schedule in the information processing apparatus according to the first embodiment.
FIG. 13 is a diagram illustrating another display example of the schedule in the information processing apparatus according to the first embodiment.
FIG. 14 is a diagram illustrating an example of a headway data setting screen displayed in an information processing apparatus according to a second embodiment.
FIG. 15 is a diagram illustrating an example of a travel route screen displayed in the information processing apparatus according to the second embodiment.
FIG. 16 is a diagram illustrating another example of the travel route screen displayed in the information processing apparatus according to the second embodiment.
FIG. 17 is a diagram illustrating an example of a track condition setting screen displayed in an information processing apparatus according to a third embodiment.
FIG. 18 is a diagram illustrating a display example of a schedule in an information processing apparatus according to a fourth embodiment.
FIG. 19 is a diagram illustrating another display example of the schedule in the information processing apparatus according to the fourth embodiment.

DETAILED DESCRIPTION

[0008] Hereinafter, an example of an information processing apparatus to which a device for creating a track use plan and a method for creating a track use plan according to embodiments are applied will be described using the accompanying drawings.

(First Embodiment)

[0009] FIG. 1 is a diagram illustrating an example of a hardware configuration of an information processing apparatus according to a first embodiment. As illustrated in FIG. 1, the information processing apparatus according to the present embodiment includes a central processing unit (CPU) 101, a read only memory (ROM) 102, a random access memory (RAM) 103, an input/output interface 104, a system bus 105, an input device 106, a display device 107, an auxiliary storage device 108, and a communication device 109. The CPU 101, the ROM 102, the RAM 103, and the input/output interface 104 are connected together via the system bus 105.

[0010] The CPU 101 is an example of a processor controlling the entire information processing apparatus. The ROM 102 is a nonvolatile memory storing various information such as computer programs to be executed by the CPU 101. The RAM 103 is a work area used by the CPU 101 in executing the computer programs.

[0011] The input device 106 is, for example, a keyboard, a mouse, or a touch panel, and is an operation unit that can be operated by users. The display device 107 is a display that displays various information such as a train schedule. The auxiliary storage device 108 is, for example, a hard disk drive (HDD) or a solid state drive (SSD) and stores various information such as station track allocation results for train lines (referred to as schedule line below) included in the schedule. The communication device 109 controls communication between the information processing apparatus and an external apparatus.

[0012] FIG. 2 is a block diagram illustrating an example of a functional configuration of the information processing apparatus according to the first embodiment. As illustrated in FIG. 2, the information processing apparatus according to the present embodiment includes a line section master storage 201, a station sequence master storage 202, a section master storage 203, a track master storage 204, a headway data storage 205, a vehicle operation master storage 206, a schedule data storage 207, a line section determinator 208, a station determinator 209, a section data reader 210, a track data reader 211, a headway data reader 212, a vehicle operation data reader 213, a schedule data reader 214, a

track use plan display processor 215, and a track use plan creator 216.

[0013] The line section master storage 201 stores line section data for each line section on which trains are operated as shown in Table 1 below. The line section data includes a line section code and a line section name. Here, the line section code is information that enables identification of the line section. The line section name is a name of the line section.

Table 1

Line section code	Line section name (route name)
1	α line
2	β line
3	γ line

[0014] The station sequence master storage 202 stores station sequence data for each station as shown in Table 2 below. The station sequence data includes a line section code, a station sequence code, a station name, and a station kilometrage. Here, the line section code is information that enables identification of a line section to which the station belongs. The station sequence code is a code indicating a sequence number of the station from a preset reference station (e.g., a starting station). The station name is a name of the station. The station kilometrage is a distance of the station from the reference station.

Table 2

Line section code	Station sequence code	Station name	Station kilometrage
1	1	A station	0.0
1	2	B station	1.3
1	3	C station	2.1
2	1	X station	0.0
2	2	Y station	1.3
2	3	B station	1.9
3	1	A station	0.0
3	2	N station	1.1

[0015] The section master storage 203 stores section data for each section (e.g., between stations) on which trains are operated as shown in Table 3 below. The section data includes a section code, a section name, a start line section code, a start station sequence code, a start kilometrage, an end line section code, an end station sequence code, an end kilometrage, and a travel direction. Here, the section code is information that enables identification of the section. When the section is a double-track or quadruple-track section, a plurality of section codes are registered for the same section. The section name is a name of the section indicated by the section code.

[0016] The start line section code is a line section code of a line section to which a start point of the section belongs. The start station sequence code is a station sequence code of a station as the section start point. The start kilometrage is a station kilometrage of the station as the section start point. The end line section code is a line section code of a line section to which an end point of the section belongs. The end station sequence code is a station sequence code of a station as the section end point. The end kilometrage is a station kilometrage of the station as the section end point. The travel direction is a direction in which the trains operated on the section travel. For example, the travel direction is represented by "0" indicating that the trains travel in two directions of an inbound direction and an outbound direction, "1" indicating that the trains travel in the inbound direction, or "-1" indicating that the trains travel in the outbound direction.

Table 3

Section code	Section name	Start line section code	Start station sequence code	Start kilometrage	End line section code	End station sequence code	End kilometrage	Travel direction
1	A01	1	1	0	1	2	0.1	0
2	A02	1	1	0.1	1	2	1.4	1
3	A03	1	1	1.4	1	2	2.1	-1

[0017] The track master storage 204 stores track data for each track of a station as shown in Table 4 below. The track data includes a station name, a track code, a condition type, and a track condition. Here, the station name is a name of a station to which the track belongs. The track code is information that enables identification of the track. The condition type is a type of the track condition described later. The track condition is information indicating an attribute of a train allocatable to the track.

Table 4

Station name	Track code	Track name	Condition type	Track condition
A station	1	Track 1	Train classification	Local train
A station	1	Track 1	Direction	For B station
A station	2	Track 2	Train classification	Limited express train

[0018] The headway data storage 205 stores headway data for each train to which a track is allocated (referred to as succeeding train below) as shown in Table 5 below. The headway data includes a station name, a preceding train track code, a preceding train section code, a succeeding train track code, a succeeding train section code, a headway pattern, a headway classification, and an operation headway.

Table 5

Station name	Preceding train track code	Preceding train section code	Succeeding train track code	Succeeding train section code	Headway pattern	Headway classification	Operation headway
A station	1	105	2	106	Departure-Arrival	Crossover	36
A station	1	105	2	106	Arrival-Departure	Crossover	43
A station	2	105	2	106	Departure-Departure	Continuation	45

[0019] Here, the station name is a name of a station used by the succeeding train. The preceding train track code is a track code of a track allocated to a preceding train preceding the succeeding train. The preceding train section code is a section code of a section on which the preceding train runs before arriving at or after departing from the station. The succeeding train track code is a track code of a track allocated to the succeeding train. The succeeding train section code is a section code of a section on which the succeeding train runs before arriving at or after departing from the station.

[0020] The headway pattern is a combination of respective operations of the preceding train and the succeeding train at the station. Examples of the train operation at the station include departure, arrival, and passing. Examples of the combination of the respective operations of the preceding train and the succeeding train include departure-departure, arrival-arrival, passing-passing, departure-passing, passing-departure, arrival-passing, and passing-arrival. The depar-

ture-departure indicates that both the preceding and succeeding trains depart from the station. The arrival-arrival indicates that both the preceding and succeeding trains arrive at the station. The passing-passing indicates that both the preceding and succeeding trains pass the station. The departure-passing indicates that the preceding train departs from the station and the succeeding train passes the station. The passing-departure indicates that the preceding train passes the station and the succeeding train departs from the station. The arrival-passing indicates that the preceding train arrives at the station and the succeeding train passes the station. The passing-arrival indicates that the preceding train passes the station and the succeeding train arrives at the station.

[0021] The headway classification indicates a type of the operation headway. The type of the operation headway includes crossover and continuation. The crossover indicates an operation headway between the preceding train and the succeeding train crossing at the station. The continuation indicates an operation headway between the preceding train and the succeeding train continuing at the station. The operation headway indicates a headway between the preceding train and the succeeding train at the station.

[0022] The vehicle operation master storage 206 stores vehicle operation data for each schedule line as shown in Table 6 below. The vehicle operation data includes a vehicle operation code, an operation sequence, a schedule plan code, a subsequent operation code, a train classification, an operation direction, an operation company, and the number of vehicles. The vehicle operation code is information that enables identification of a series of operations of a train. The operation sequence indicates a sequence number of each schedule line executed in the series of operations of the train. The schedule plan code is information that enables identification of the schedule line of the train. The subsequent operation code is a vehicle operation code to be executed subsequently. The train classification indicates a train classification such as an express train, a semi-express train, a rapid train, a limited express train, a semi-limited express train, a semi-rapid train, a special rapid train, and a local train. The operation direction indicates a destination of the train. The operation company is a company that manages the train. The number of vehicles is the number of vehicles constituting the train.

Table 6

Vehicle operation code	Operation sequence	Schedule plan code	Subsequent operation code	Train classification	Operation direction	Operation Company	Vehicle number
1	1	1	4	Local train	For A station	A	4
1	2	2	4	Local train	For B station	A	4
1	3	3	4	Local train	For A station	A	4
2	1	9	9	Express train	For C station	X	8
2	2	10	9	Express train	For D station	X	8

[0023] The schedule data storage 207 stores schedule data for each schedule line as shown in Table 7 below. The schedule data includes a schedule plan code, a line section code, a station sequence code, a track code, an intermediate section code before arriving at a station, an intermediate section code after departing from a station, an arrival time, and a departure time. The schedule plan code is information that enables identification of the schedule line. The line section code is a line section code of a line section on which a train is operated according to the schedule line. The track code is a track code of a track allocated to the schedule line. The intermediate section code before arriving at a station is a section code of a section that the train operated according to the schedule line finally passes before arriving at the station. The intermediate section code after departing from a station is a section code of a section that the train operated according to the schedule line first passes after departing from the station. The arrival time is a time when the train operated according to the schedule line arrives at the station. The departure time is a time when the train operated according to the schedule line departs from the station.

Table 7

Schedule data plan code	Line section code	Station sequence code	Track code	Intermediate section code before arriving at station	Intermediate section code after departing from station	Arrival time	Departure time
1	1	1	1	A01	107	09:09:30	09:10:00
1	1	3	10	A02	108	09:14:00	09:15:00
1	1	5	11	A03	109	09:21:00	09:21:30
2	2	1	1	B01	201	09:29:30	09:30:00
2	2	3	10	B05	202	09:34:00	09:35:00

[0024] The line section determinator 208 determines a line section code of a line section where tracks are allocated to trains (referred to as target line section below) by referring to the line section data stored in the line section master storage 201.

[0025] The station determinator 209 determines a station sequence code of a station where tracks are allocated to trains (referred to as target station below) by referring to station sequence data including the line section code of the target line section out of the station sequence data stored in the station sequence master storage 202. To be more specific, the station determinator 209 determines, as the station sequence code of the target station, at least one station sequence code selected by a user via the input device 106 out of station sequence codes included in the station sequence data of the target line section.

[0026] The section data reader 210 reads section data of sections included in the target line section from the section master storage 203.

[0027] The track data reader 211 reads, from the track master storage 204, track data including a station name of the target station indicated by the station sequence code determined by the station determinator 209.

[0028] The headway data reader 212 reads, from the headway data storage 205, headway data including the station name of the target station indicated by the station sequence code determined by the station determinator 209.

[0029] The vehicle operation data reader 213 reads vehicle operation data including vehicle operation codes of the trains using the target station from the vehicle operation master storage 206.

[0030] The schedule data reader 214 reads, from the schedule data storage 207, schedule data including schedule plan codes included in the vehicle operation data read by the vehicle operation data reader 213.

[0031] The track use plan display processor 215 creates a schedule for the trains using the target station on the basis of the schedule data read by the schedule data reader 214. In the present embodiment, the track use plan display processor 215 creates a schedule including a schedule line of a succeeding train and track information that enables identification of a track allocated to the succeeding train (an example of a target train). The track use plan display processor 215 (an example of a display controller) displays the created schedule on the display device 107.

[0032] The track use plan creator 216 (an example of a selector) selects the schedule line of the succeeding train (an example of the target train) to which the track is to be allocated at the target station out of schedule lines included in the created schedule. The track use plan creator 216 (an example of an allocator) then allocates, to the schedule line of the succeeding train, the track according to track conditions included in the track data read by the track data reader 211.

[0033] When no track can be allocated to the schedule line of the succeeding train according to the track conditions, the track use plan creator 216 allocates, to the schedule line of the succeeding train, a track having the shortest operation headway with a preceding train out of the tracks of the target station on the basis of an operation headway on each track between the succeeding train and the preceding train out of the operation headways included in the headway data read by the headway data reader 212. This reduces a time required for crossover or continuation of the preceding train and the succeeding train at the target station, thereby achieving a short-interval operation of the preceding train and the succeeding train. As a result, few problems occur in the operation of the preceding train and the succeeding train, and this ensures a margin time long enough to perform train operation arrangement and delay recovery.

[0034] FIG. 3 is a flowchart illustrating an example of a track allocation processing flow in the information processing

apparatus according to the first embodiment. First, the line section determinator 208 determines the line section code of the target line section by referring to the line section data stored in the line section master storage 201 (step S301). Additionally, the station determinator 209 determines the station sequence code of the target station by referring to the station sequence data including the line section code of the target line section out of the station sequence data stored in the station sequence master storage 202 (step S301).

[0035] Subsequently, the vehicle operation data reader 213 reads the vehicle operation data of the trains using the target station from the vehicle operation master storage 206. The schedule data reader 214 then reads, from the schedule data storage 207, the schedule data including the schedule plan codes corresponding to the schedule plan codes included in the vehicle operation data read by the vehicle operation data reader 213 (S302). The track use plan display processor 215 creates the schedule for the trains using the target station on the basis of the schedule data read by the schedule data reader 214 and displays the schedule on the display device 107 (S302).

[0036] FIG. 4 is a diagram illustrating an example of a railway network for which a schedule is created in the information processing apparatus according to the first embodiment. FIG. 5 is a diagram illustrating an example of a schedule of a terminal station created by the information processing apparatus according to the first embodiment. In the schedule illustrated in FIG. 5, a vertical axis represents a kilometrage, and a horizontal axis represents a time.

[0037] For example, the line section determinator 208 determines the line section code of the target line section (e.g., α line section) from a plurality of line sections including α line section, β line section, γ line section, and δ line section as illustrated in FIG. 4. The station determinator 209 then determines the station sequence code of the target station (e.g., H station as the terminal station) out of stations (e.g., L station and H station) included in the α line section. The track data reader 211 then reads the track data including the H station as the station name from the track master storage 204. Additionally, the vehicle operation data reader 213 reads the vehicle operation data of the trains using the H station from the vehicle operation master storage 206. Moreover, the schedule data reader 214 reads, from the schedule data storage 207, the schedule data including the schedule plan codes corresponding to the schedule plan codes included in the read vehicle operation data.

[0038] The track use plan display processor 215 creates a schedule D for the trains on the α line section using the H station on the basis of the read schedule data as illustrated in FIG. 5. The track use plan display processor 215 also incorporates, to the schedule D, the track information that enables identification of which tracks are used by the schedule lines of the trains on the α line section using the H station out of the tracks (e.g., track 1, track 2, track 3, and track 4) of the H station as illustrated in FIG. 5.

[0039] FIG. 6 is a diagram illustrating another example of the railway network for which a schedule is created in the information processing apparatus according to the first embodiment. FIG. 7 is a diagram illustrating an example of a schedule of an intermediate station created by the information processing apparatus according to the first embodiment. In the schedule illustrated in FIG. 7, a vertical axis represents a kilometrage, and a horizontal axis represents a time.

[0040] For example, the line section determinator 208 determines the line section code of the target line section (e.g., α line section) from a plurality of line sections including α line section, β line section, and γ line section as illustrated in FIG. 6. The station determinator 209 then determines the station sequence code of the target station (e.g., B station as the intermediate station) out of stations (e.g., A station, B station, and G station) included in the α line section. The track data reader 211 then reads the track data including the B station as the station name from the track master storage 204. Additionally, the vehicle operation data reader 213 reads the vehicle operation data of the trains using the B station from the vehicle operation master storage 206. Moreover, the schedule data reader 214 reads, from the schedule data storage 207, the schedule data including the schedule plan codes corresponding to the schedule plan codes included in the read vehicle operation data.

[0041] The track use plan display processor 215 creates a schedule D for the trains on the α line section using the B station on the basis of the read schedule data as illustrated in FIG. 7. The track use plan display processor 215 incorporates, to the schedule D, the track information that enables identification of which tracks are used by the schedule lines of the trains on the α line section using the B station out of the tracks (e.g., track 1, track 2, and track 3) of the B station as illustrated in FIG. 7.

[0042] While an example in which the schedule for the trains using the terminal station or the intermediate station is created is described in the present embodiment, the present invention is not limited to this example, and the schedule can be created for trains using any station within a single-track, double-track, or quadruple-track railway network including one or more line sections. Additionally, although track allocation to trains at stations is described in the present embodiment, when transportation means such as buses, automobiles and airplanes uses arrival points and via points in operations of transportation and physical distribution, the present invention can also be applied to allocation of terminals, parking places, traffic lanes, airport gates, airport runways or the like to the transportation means at the arrival points or the via points.

[0043] Returning to FIG. 3, when the schedule is created by the track use plan display processor 215, the headway data reader 212 reads, from the headway data storage 205, the headway data including the station name of the target station indicated by the station sequence code determined by the station determinator 209 (step S303). The track data

reader 211 also reads, from the track master storage 204, the track data including the station name of the target station indicated by the station sequence code determined by the station determinator 209 (step S304).

[0044] Subsequently, the track use plan creator 216 selects the schedule line (referred to as calculation target line) to which the track is to be allocated out of the schedule lines included in the schedule created by the track use plan display processor 215 (step S305). In the present embodiment, the track use plan creator 216 selects, as the calculation target line, two schedule lines having the same vehicle operation code included in the vehicle operation data read by the vehicle operation data reader 213 out of the schedule lines included in the schedule. When the read vehicle operation data includes the operation sequence, the track use plan creator 216 selects two schedule lines continuous in the operation sequence included in the vehicle operation data as the calculation target line. Meanwhile, when the read vehicle operation data does not include the operation sequence, the track use plan creator 216 selects two schedule lines connectable within a shortest time out of schedule lines having a longer connection time than a preset minimum connection time as the calculation target line. Here, the minimum connection time is a minimum time required for connection of two schedule lines.

[0045] Additionally, in the present embodiment, the track use plan creator 216 uses, for example, a method of selecting two schedule lines sequentially from a preset time toward a travel direction, a method of selecting two schedule lines sequentially from a preset time toward a return direction, a method of selecting two schedule lines sequentially from those with a longer track occupancy time, a method of selecting two schedule lines sequentially from those with a shorter operation headway, and a method of selecting two schedule lines sequentially from those with fewer choices of tracks to be allocated, in selecting the two schedule lines.

[0046] Subsequently, the track use plan creator 216 specifies a track not to be allocated (entry prohibited track below) at the target station on the basis of the operation headway between the two schedule lines selected as the calculation target line or the track occupancy state at the target station (step S306). When all the tracks of the target station cannot be used due to, for example, construction or an accident, the track use plan display processor 215 displays an error message instructing recreation of the schedule on the display device 107.

[0047] The track use plan creator 216 also determines whether the track can be allocated to the calculation target line on the basis of the track conditions included in the track data of the allocatable tracks of the target station (step S307). If the track can be allocated to the calculation target line on the basis of the track conditions (step S307: Yes), the track use plan creator 216 allocates, to the calculation target line, the track of the target station on the basis of the track conditions (step S308). At this point, the track use plan creator 216 allocates, to the calculation target line, a track other than the entry prohibited track out of the tracks of the target station. Additionally, when there are a plurality of tracks having the same track condition, the track use plan creator 216 allocates, to the calculation target line, the tracks having the same track condition in a preset sequence (e.g., alternately). Alternatively, the track use plan creator 216 allocates, to the calculation target line, a track having a highest preset priority out of the tracks having the same track condition.

[0048] On the other hand, if no track can be allocated to the calculation target line on the basis of the track conditions (step S307: No), the track use plan creator 216 allocates a track having the shortest operation headway with the preceding train to the calculation target line of the succeeding train as the train on the calculation target line on the basis of an operation headway on each track between the succeeding train and the preceding train out of the operation headways included in the headway data read by the headway data reader 212 (step S309). This reduces a time required for crossover or continuation of the preceding train and the succeeding train at the target station, thereby achieving a short-interval operation of the preceding train and the succeeding train. As a result, few problems occur in the operation of the preceding train and the succeeding train, and this ensures a margin time long enough to perform train operation arrangement and delay recovery.

[0049] In the present embodiment, the track use plan creator 216 obtains the operation headway on each track between the preceding train and the succeeding train for all the headway patterns achieved by the preceding train and the succeeding train. The track use plan creator 216 allocates, to the calculation target line, the track having the shortest operation headway on the basis of the operation headways on each track obtained for all the headway patterns. Additionally, in the present embodiment, the track use plan creator 216 may display, in a case where the track is not able to be allocated to the schedule line of the succeeding train on the basis of the operation headways, the occasion of the case on the display device 107. Moreover, when the succeeding train is parked at the target station after finishing an operation, the track use plan creator 216 may allocate the track to the schedule line of the succeeding train such that a track that the succeeding train enters after finishing the operation and a track from which the succeeding train departs in starting the operation correspond to each other. This makes it unnecessary for the succeeding train to move between tracks in starting the operation, and thus, the succeeding train can be operated more efficiently at the target station.

[0050] The track use plan creator 216 determines whether the tracks have been allocated to all the schedule lines included in the created schedule every time the track allocation to the calculation target line is completed (step S310). If the track allocation to all the schedule lines included in the created schedule is not completed (step S310: No), the process returns to the step S305, and the track use plan creator 216 selects, as the calculation target line, a schedule line to which the track has not been allocated out of the schedule lines included in the created schedule.

[0051] On the other hand, if the tracks have been allocated to all the schedule lines included in the created schedule (step S310: Yes), the track use plan creator 216 determines whether the tracks are allocated to the trains using all the stations included in the target line section (step S311). If the track allocation to the trains using all the stations included in the target line section is not completed (step S311: No), the process returns to the step S301, and the station determinator 209 determines, as the station sequence code of the target station, a station where the track allocation has not been performed out of the stations included in the target line section.

[0052] Additionally, if the tracks have been allocated for all the stations included in the target line section (step S311: Yes), the track use plan creator 216 stores the track allocation results performed for all the stations included in the target line section in the schedule data storage 207 (step S312). Moreover, the track use plan display processor 215 displays the schedule including the track information that enables identification of the tracks allocated to the trains using the stations on the display device 107 (step S313).

[0053] FIG. 8 is a diagram illustrating an example of the schedule created by the information processing apparatus according to the first embodiment. FIG. 9 is a diagram illustrating examples of the track condition of the track allocated to the train in the information processing apparatus according to the first embodiment. FIG. 10 is a diagram illustrating examples of the attribute of the succeeding train in the information processing apparatus according to the first embodiment. FIG. 11 is a diagram illustrating examples of the operation headway between the succeeding train and the preceding train in the information processing apparatus according to the first embodiment.

[0054] The track use plan display processor 215 creates a schedule D for the trains using the A station as an example of the target station as illustrated in FIG. 8. Subsequently, the track use plan creator 216 selects, as the calculation target line, schedule lines L-a and L-b from schedule lines L-a, L-b, L-c, L-d, L-e, L-f, and L-g included in the schedule D. The track use plan creator 216 further compares the track conditions (see FIG. 9) included in the track data of the tracks of the A station and the attributes (see FIG. 10) of a train on the schedule lines L-a and L-b. The track use plan creator 216 allocates, to the schedule lines L-a and L-b, the track (track 1) having a track condition satisfying the attributes (see FIG. 10) of the train on the schedule lines L-a and L-b out of the tracks 1 to 3 of the A station. When selecting the schedule lines L-c and L-d as the calculation target line, the track use plan creator 216 similarly allocates the track (track 2) having a track condition satisfying the attributes of a train on the schedule lines L-c and L-d.

[0055] Meanwhile, when no track has a track condition satisfying the attributes of a train on the schedule lines L-e and L-f selected as the calculation target line, the track use plan creator 216 specifies the operation headway between the succeeding train on the schedule lines L-e and L-f and the preceding train (trains on the schedule lines L-d and L-g) for each track that can be used by the succeeding train as illustrated in FIG. 11. At this point, the track use plan creator 216 specifies, for each track, the operation headways in all the headway patterns (departure-arrival of the schedule lines L-d and L-e, passing-arrival of the schedule lines L-g and L-e, arrival-departure of the schedule lines L-g and L-f, and passing-departure of the schedule lines L-g and L-f) at the A station between the succeeding train on the schedule lines L-e and L-f and the preceding train on the schedule lines L-d and L-g as illustrated in FIG. 11. The track use plan creator 216 allocates, to the succeeding train on the schedule lines L-e and L-f, the track 1 having the shortest operation headway with the preceding train out of the tracks 1 to 3 of the A station that can be used by the succeeding train on the schedule lines L-e and L-f.

[0056] FIGS. 12 and 13 are diagrams illustrating display examples of the schedule in the information processing apparatus according to the first embodiment. When the schedule D of the terminal station (e.g., the H station in FIG. 4) is displayed including the track information, the track use plan display processor 215 connects two schedule lines (e.g., schedule lines L-h and L-k), which connect with each other at the H station, on the track 1 allocated to the schedule lines L-h and L-k to form one schedule line as illustrated in FIG. 12. The track information that enables identification of the track allocated to the two schedule lines L-h and L-k connecting at the H station is thereby displayed. The track use plan display processor 215 may further display a connection portion of the two schedule lines L-h and L-k connecting at the H station in a different display mode (e.g., a bold line or a different color) from another portion of the schedule lines L-h and L-k. This enables easy identification of the track allocated to the two schedule lines connecting at the H station. As illustrated in FIG. 12, as for other schedule lines L-i, L-j, L-l, L-m and L-n included in the schedule D, the track use plan display processor 215 similarly displays the track information that enables identification of the tracks allocated to the other schedule lines L-i, L-j, L-l, L-m and L-n.

[0057] When the schedule D of the intermediate station (e.g., the B station in FIG. 6) is displayed including the track information, the track use plan display processor 215 also connects two schedule lines (e.g., schedule lines L-o and L-v), which connect with each other at the B station, on the track 1 allocated to the schedule lines L-o and L-v to form one schedule line as illustrated in FIG. 13. The track use plan display processor 215 further displays a connection portion of the two schedule lines L-o and L-v connecting at the B station in a different display target from another portion of the schedule lines L-o and L-v as illustrated in FIG. 12. As illustrated in FIG. 13, as for other schedule lines L-p, L-q, L-r, L-s, L-t, L-u and L-w included in the schedule D, the track use plan display processor 215 similarly displays the track information that enables identification of the tracks allocated to the other schedule lines L-p, L-q, L-r, L-s, L-t, L-u and L-w.

[0058] As described above, the information processing apparatus according to the first embodiment can reduce a time

required for crossover or continuation of the preceding train and the succeeding train at the target station, thereby achieving a short-interval operation of the preceding train and the succeeding train. As a result, few problems occur in the operation of the preceding train and the succeeding train, and this ensures a margin time long enough to perform train operation arrangement and delay recovery.

(Second Embodiment)

[0059] In this embodiment, a headway data setting screen that enables setting of the operation headway on each track between the succeeding train and the preceding train is displayed, and the track is allocated to the schedule line of the succeeding train on the basis of an operation headway set by using the headway data setting screen. In the following description, description of configurations similar to those of the first embodiment will be omitted.

[0060] FIG. 14 is a diagram illustrating an example of the headway data setting screen displayed in the information processing apparatus according to the second embodiment. In the present embodiment, the track use plan display processor 215 displays, on the display device 107, the headway data setting screen that enables setting of the operation headway on each track between the succeeding train and the preceding train at the target station. This enables the operation headway on each track between the succeeding train and the preceding train at the target station to be changed to a measured operation headway, and thus, the track can be allocated to the succeeding train on the basis of the accurate operation headway. For example, the track use plan display processor 215 displays a headway data setting screen 1400 including a headway data table 1401 and a time adjustment button 1402 on the display device 107 as illustrated in FIG. 14.

[0061] The headway data table 1401 is a table displaying the operation headways in all the headway patterns between the preceding train and the succeeding train for each track of the target station that can be used by the succeeding train. The time adjustment button 1402 is a button used to adjust the operation headway included in the headway data table 1401 with the minimum connection time as a lower limit. For example, when the operation headway included in the headway data table 1401 is 34 seconds and the measured operation headway is 30 seconds, a user of the information processing apparatus resets the operation headway to 30 seconds by operating the time adjustment button 1402 via the input device 106.

[0062] FIGS. 15 and 16 are diagrams illustrating examples of a travel route screen displayed in the information processing apparatus according to the second embodiment. In the present embodiment, when the user selects the operation headway included in the headway data setting screen, the track use plan display processor 215 displays, on the display device 107, the travel route screen indicating travel routes at the target station of the preceding train and the succeeding train according to the selected operation headway.

[0063] For example, when the target station is the intermediate station, the track use plan display processor 215 displays, on the display device 107, a travel route screen 1500 including a platform 1501 of the target station, tracks 1502 of the target station, a travel route 1503 of the succeeding train, a travel route 1504 of the preceding train, and section information 1505 indicating sections on which the preceding train and the succeeding train run after departing from or before arriving at the target station as illustrated in FIG. 15.

[0064] The track use plan display processor 215 displays, as the travel route 1504 of the preceding train, a route connecting a travel route at the target station of the preceding train according to the operation headway selected using the headway data setting screen 1400 and a travel route of the preceding train after departing from or before arriving at the target station. The track use plan display processor 215 also displays, as the travel route 1503 of the succeeding train, a route connecting a route at the target station of the succeeding train according to the operation headway selected using the headway data setting screen and a travel route of the succeeding train after departing from or before arriving at the target station. The travel routes 1503 and 1504 of the preceding and succeeding trains according to the setting change of the operation headway can be thereby efficiently checked.

[0065] Additionally, when the target station is the terminal station, the track use plan display processor 215 displays, on the display device 107, a travel route screen 1500 including a platform 1501 of the target station, tracks 1502 of the target station, a travel route 1503 of the succeeding train, a travel route 1504 of the preceding train, and section information 1505 indicating sections on which the preceding train and the succeeding train run after departing from or before arriving at the target station as illustrated in FIG. 16.

[0066] The track use plan display processor 215 displays, as the travel route 1504 of the preceding train, a route connecting a travel route at the target station of the preceding train according to the operation headway selected using the headway data setting screen 1400 and a travel route of the preceding train after departing from or before arriving at the target station. The track use plan display processor 215 also displays, as the travel route 1503 of the succeeding train, a route connecting a route at the target station of the succeeding train according to the operation headway selected using the headway data setting screen 1400 and a travel route of the succeeding train after departing from or before arriving at the target station.

[0067] As described above, the information processing apparatus according to the second embodiment can change

the operation headway on each track between the succeeding train and the preceding train at the target station to the measured operation headway, and thus, the track can be allocated to the succeeding train on the basis of the accurate operation headway.

(Third Embodiment)

[0068] In this embodiment, a track condition setting screen that enables setting of the track condition is displayed, and the track is allocated to the schedule line of the target train according to a track condition set by using the track condition setting screen. In the following description, description of configurations similar to those of the first embodiment will be omitted.

[0069] FIG. 17 is a diagram illustrating an example of the track condition setting screen displayed in the information processing apparatus according to the third embodiment. In the present embodiment, the track use plan display processor 215 displays the track condition setting screen that enables setting of the track condition of the target station on the display device 107. This enables the track condition of the target station to be changed. The track use plan creator 216 allocates the track to the schedule line of the target train according to the track condition set using the track condition setting screen. Since the track condition of the target station can be changed, the present embodiment can promptly respond to a case in which the track condition is changed due to construction or the like at the target station.

[0070] For example, the track use plan display processor 215 displays a track condition setting screen 1700 including a track condition table 1701, a restoration button 1702, and an update button 1703 on the display device 107 as illustrated in FIG. 17. The track condition table 1701 includes the condition type and the track condition. The restoration button 1702 is a button used to instruct restoration of the changed track condition to the preset track condition (an initial value). The update button 1703 is a button used to instruct update of the track condition included in the track condition table 1701 to the changed track condition.

[0071] A user of the information processing apparatus can change the track condition included in the track condition table 1701 by pushing the update button 1703 after inputting the track condition via the input device 106. The user of the information processing apparatus can also restore the track condition included in the track condition table 1701 to the initial value by pushing the restoration button 1702 via the input device 106.

[0072] In the present embodiment, when the user selects the track condition included in the track condition setting screen 1700, the track use plan display processor 215 displays, on the display device 107, the travel route screen 1500 (see FIGS. 15 and 16) indicating the travel routes at the target station of the preceding train and the succeeding train to which the tracks are allocated according to the selected track condition.

[0073] As described above, the information processing apparatus according to the third embodiment can change the track condition of the target station, and thus, the present embodiment can promptly respond to the case in which the track condition is changed due to construction or the like at the target station.

(Fourth Embodiment)

[0074] In this embodiment, the schedule displayed on the display device includes a hide button used to give an instruction to hide the track information included in the schedule, and when the hide button is pushed, the track information included in the schedule is hidden. In the following description, description of configurations similar to those of the first embodiment will be omitted.

[0075] In the present embodiment, the track use plan display processor 215 incorporates, to the created schedule, the hide button used to give an instruction to hide the track information included in the created schedule and displays the schedule on the display device 107. Thus, the track information can be displayed only when the tracks used by the trains are checked, and this prevents the schedule displayed on the display device 107 from becoming complicated and allows the easily viewable schedule to be displayed.

[0076] FIGS. 18 and 19 are diagrams illustrating display examples of the schedule in the information processing apparatus according to the fourth embodiment. For example, the track use plan display processor 215 displays a schedule D including schedule lines L of trains, track information I, and hide buttons 1801 on the display device 107 as illustrated in FIG. 18. When the hide button 1801 is pushed via the input device 106, the track use plan display processor 215 hides the track information I included in the schedule D as illustrated in FIG. 19.

[0077] As described above, the information processing apparatus according to the fourth embodiment can display the track information only when the tracks used by the trains are checked, and this prevents the schedule displayed on the display device 107 from becoming complicated and allows the easily viewable schedule to be displayed.

[0078] Note that the computer program executed in the information processing apparatus of these embodiments is provided by being previously incorporated in the ROM 102 or the like. The computer program executed in the information processing apparatus of these embodiments may be also provided by being recorded on a computer-readable recording medium such as CD-ROM, flexible disk (FD), CD-R and digital versatile disc (DVD) in an installable or executable format

file.

[0079] Moreover, the computer program executed in the information processing apparatus of these embodiments may be stored on a computer connected to a network such as the Internet and provided by being downloaded via the network. Additionally, the computer program executed in the information processing apparatus of these embodiments may be provided or distributed via a network such as the Internet.

[0080] The computer program executed in the information processing apparatus of these embodiments has a module configuration including the respective units described above (the line section determinator 208, the station determinator 209, the section data reader 210, the track data reader 211, the headway data reader 212, the vehicle operation data reader 213, the schedule data reader 214, the track use plan display processor 215, and the track use plan creator 216), and as actual hardware, the above respective units are loaded on a main memory by reading the computer program from the ROM 102 and executing the program by a processor such as the CPU 101, to generate the line section determinator 208, the station determinator 209, the section data reader 210, the track data reader 211, the headway data reader 212, the vehicle operation data reader 213, the schedule data reader 214, the track use plan display processor 215, and the track use plan creator 216 on the main memory.

[0081] While some embodiments of the present invention have been described, these embodiments are merely exemplary, and not intended to limit the scope of the invention. These novel embodiments can be implemented in various other forms, and various omissions, substitutions, and changes may be made without departing from the gist of the invention. These embodiments and their modifications are included in the scope and the gist of the invention, and also in the scope of the invention as set forth in the claims and their equivalents.

Claims

1. A device for creating a track use plan comprising:

a selector configured to select a schedule line of a target train to which a track of a station is to be allocated out of a plurality of the schedule lines included in a schedule of the station; and
an allocator configured to

allocate, to the schedule line of the target train, the track according to a track condition indicating an attribute of a train allocatable to the track, and
allocate, to the schedule line of the target train, the track having a shortest operation headway out of a plurality of the tracks on the basis of an operation headway on each track between the target train and a preceding train preceding the target train when the track is not able to be allocated to the schedule line of the target train according to the track condition.

2. The device for creating a track use plan according to claim 1, wherein the allocator further allocates, to the schedule line of the target train, the track such that the track that the target train enters after finishing an operation and the track from which the target train departs in starting the operation correspond to each other when the target train is parked at the station after finishing the operation.

3. The device for creating a track use plan according to claim 1 or 2, further comprising a display controller configured to display, in a case where the track is not able to be allocated to the schedule line of the target train on the basis of the operation headway, an occasion of the case on a display.

4. The device for creating a track use plan according to claim 3, wherein the display controller displays, on the display, the schedule including the schedule line of the target train and track information that enables identification of the track allocated to the schedule line of the target train.

5. The device for creating a track use plan according to claim 3 or 4, wherein
the display controller displays, on the display, an operation headway setting screen that enables setting of the operation headway, and
the allocator allocates, to the schedule line of the target train, the track on the basis of an operation headway set by using the operation headway setting screen.

6. The device for creating a track use plan according to any one of claims 3 to 5, wherein
the display controller displays, on the display, a track condition setting screen that enables setting of the track condition, and

the allocator allocates, to the schedule line of the target train, the track according to the track condition set by using the track condition setting screen.

7. The device for creating a track use plan according to claim 4, wherein the display controller displays, on the display, the schedule including a hide button configured to give an instruction to hide the track information, and hides the track information when the hide button is pushed.

8. A method configured to create a track use plan, the method comprising:

selecting a schedule line of a target train to which a track of a station is to be allocated out of a plurality of the schedule lines included in a schedule of the station;
allocating, to the schedule line of the target train, the track according to a track condition indicating an attribute of a train allocatable to the track; and
allocating, to the schedule line of the target train, the track having a shortest operation headway out of a plurality of the tracks on the basis of an operation headway on each track between the target train and a preceding train preceding the target train when the track is not able to be allocated to the schedule line of the target train according to the track condition.

FIG.1

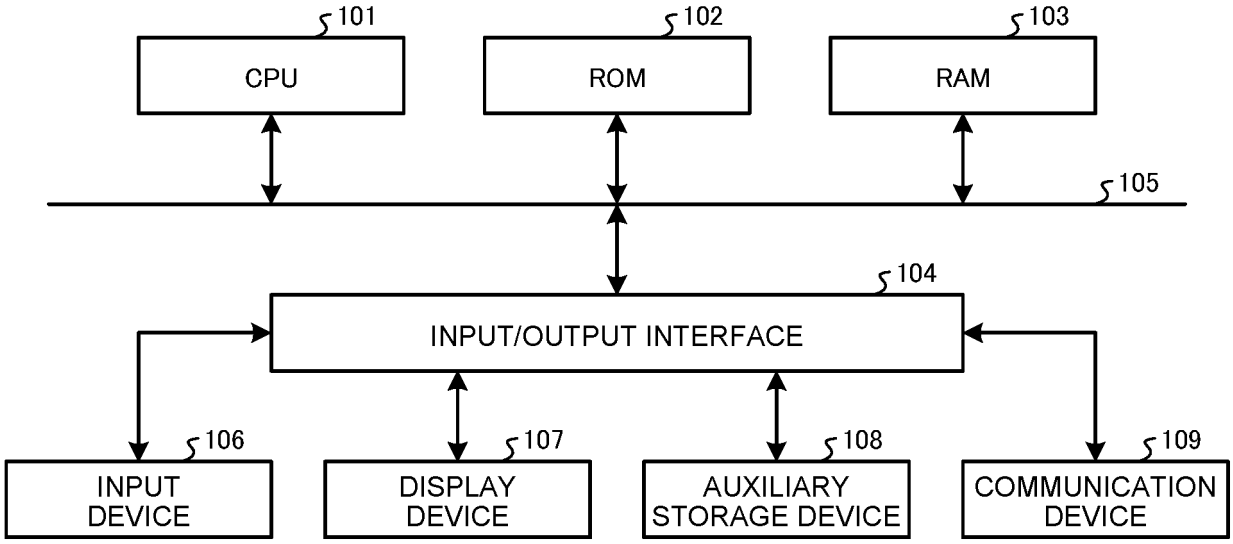

101
CPU
102
ROM
103
RAM
105
104
INPUT/OUTPUT INTERFACE
106
INPUT DEVICE
107
DISPLAY DEVICE
108
AUXILIARY STORAGE DEVICE
109
COMMUNICATION DEVICE

FIG.2

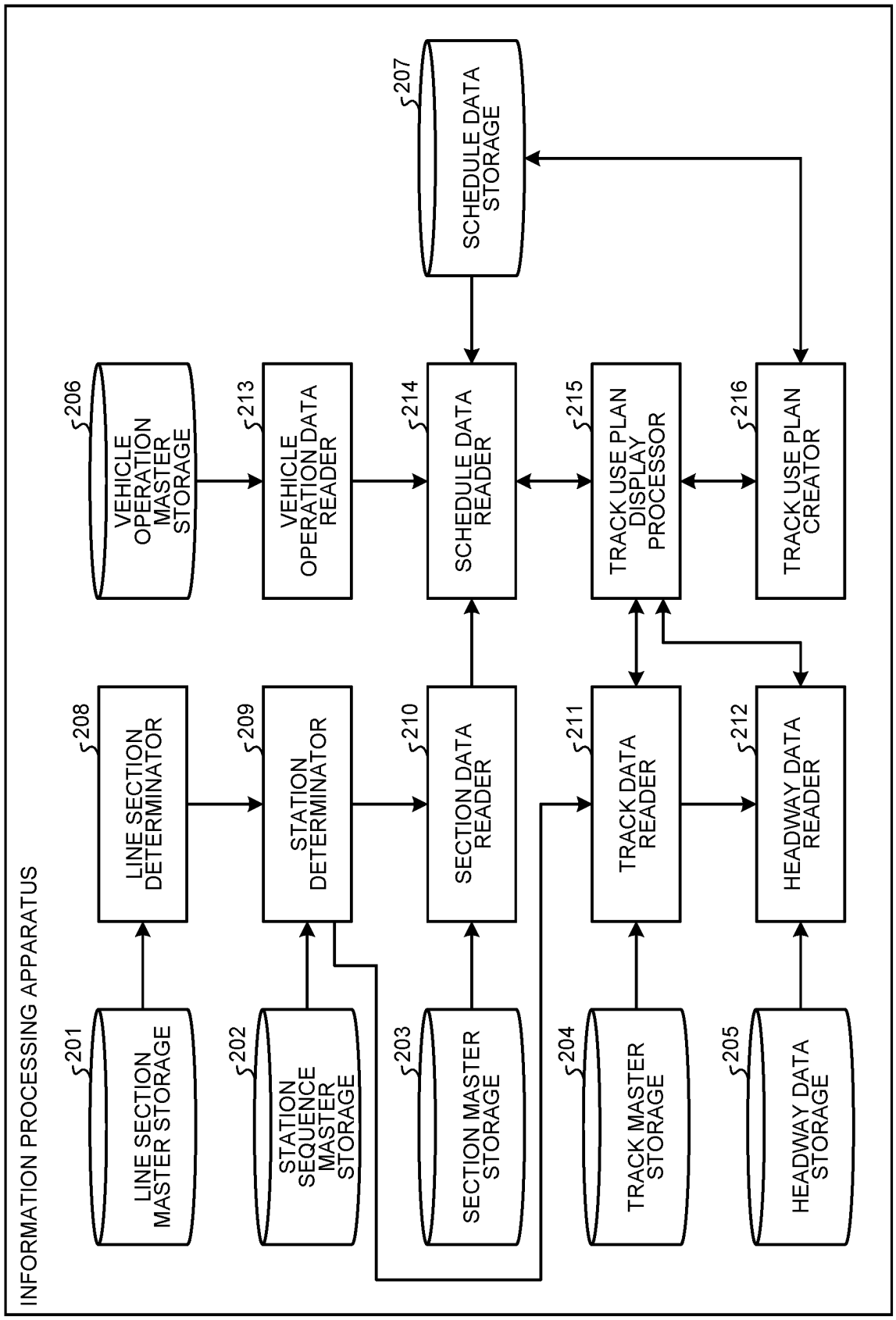

INFORMATION PROCESSING APPARATUS
201
LINE SECTION MASTER STORAGE
202
STATION SEQUENCE MASTER STORAGE
203
SECTION MASTER STORAGE
204
TRACK MASTER STORAGE
205
HEADWAY DATA STORAGE
206
VEHICLE OPERATION MASTER STORAGE
207
SCHEDULE DATA STORAGE
208
LINE SECTION DETERMINATOR
209
STATION DETERMINATOR
210
SECTION DATA READER
211
TRACK DATA READER
212
HEADWAY DATA READER
213
VEHICLE OPERATION DATA READER
214
SCHEDULE DATA READER
215
TRACK USE PLAN DISPLAY PROCESSOR
216
TRACK USE PLAN CREATOR

FIG.3

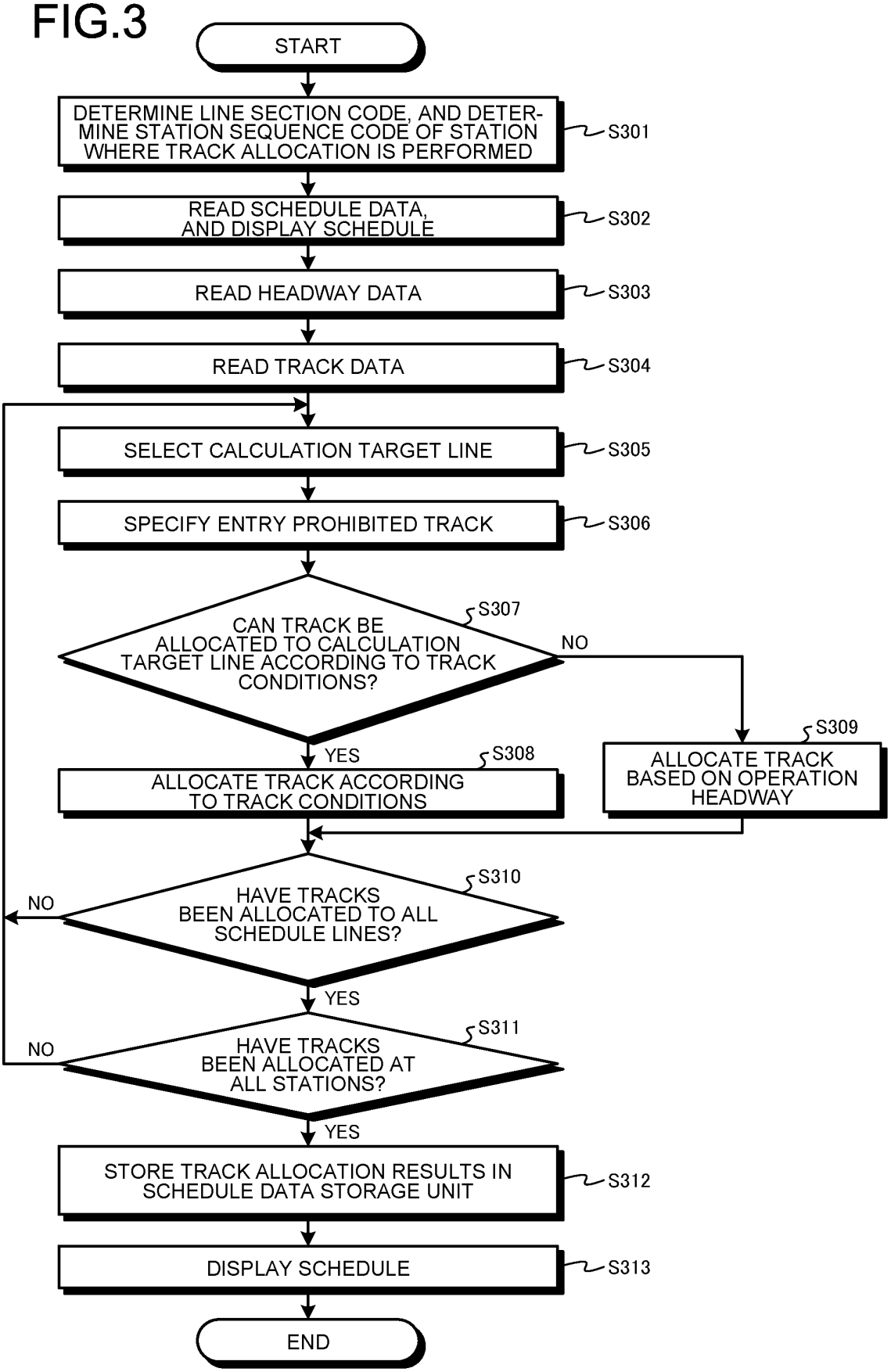

START
DETERMINE LINE SECTION CODE, AND DETERMINE STATION SEQUENCE CODE OF STATION WHERE TRACK ALLOCATION IS PERFORMED
S301
READ SCHEDULE DATA, AND DISPLAY SCHEDULE
S302
READ HEADWAY DATA
S303
READ TRACK DATA
S304
SELECT CALCULATION TARGET LINE
S305
SPECIFY ENTRY PROHIBITED TRACK
S306
CAN TRACK BE ALLOCATED TO CALCULATION TARGET LINE ACCORDING TO TRACK CONDITIONS?
S307
NO
YES
ALLOCATE TRACK ACCORDING TO TRACK CONDITIONS
S308
ALLOCATE TRACK BASED ON OPERATION HEADWAY
S309
HAVE TRACKS BEEN ALLOCATED TO ALL SCHEDULE LINES?
S310
NO
YES
HAVE TRACKS BEEN ALLOCATED AT ALL STATIONS?
S311
NO
YES
STORE TRACK ALLOCATION RESULTS IN SCHEDULE DATA STORAGE UNIT
S312
DISPLAY SCHEDULE
S313
END

FIG.4

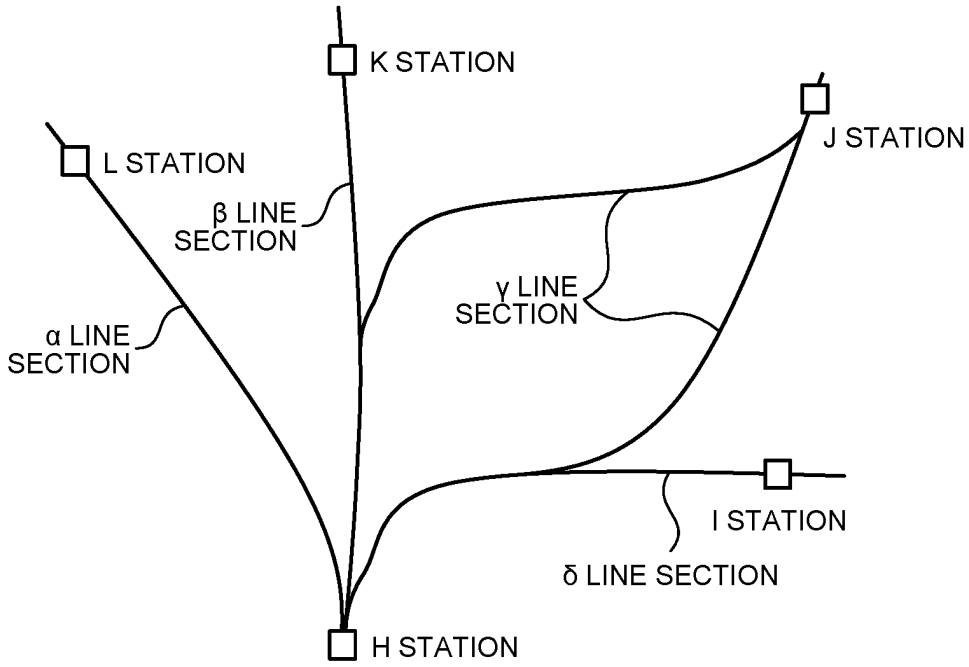

K STATION
J STATION
L STATION
β LINE SECTION
γ LINE SECTION
α LINE SECTION
I STATION
δ LINE SECTION
H STATION

FIG.5

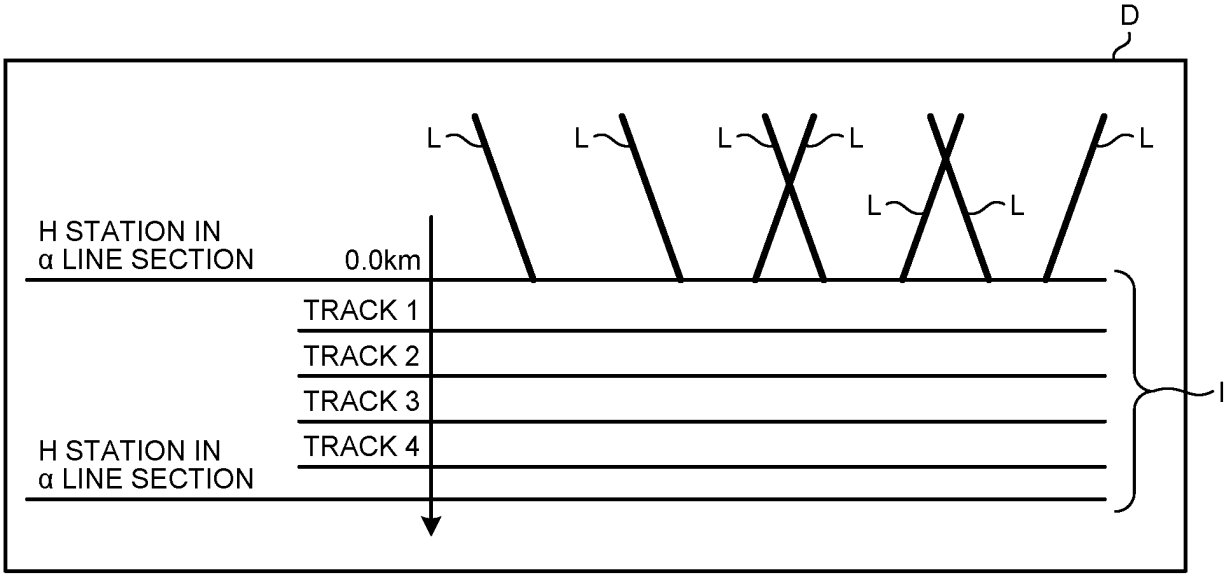

D
L
L
L
L
L
L
L
H STATION IN α LINE SECTION
0.0km
TRACK 1
TRACK 2
TRACK 3
TRACK 4
H STATION IN α LINE SECTION
I

FIG.6

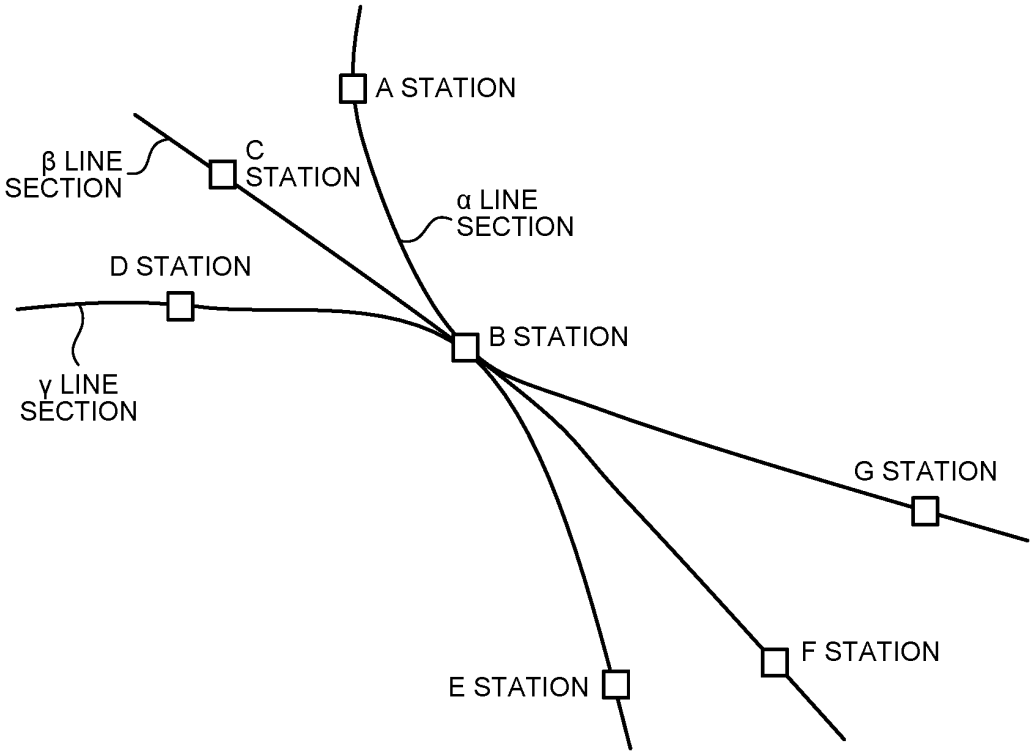

A STATION
β LINE SECTION
C STATION
α LINE SECTION
D STATION
B STATION
γ LINE SECTION
G STATION
F STATION
E STATION

FIG.7

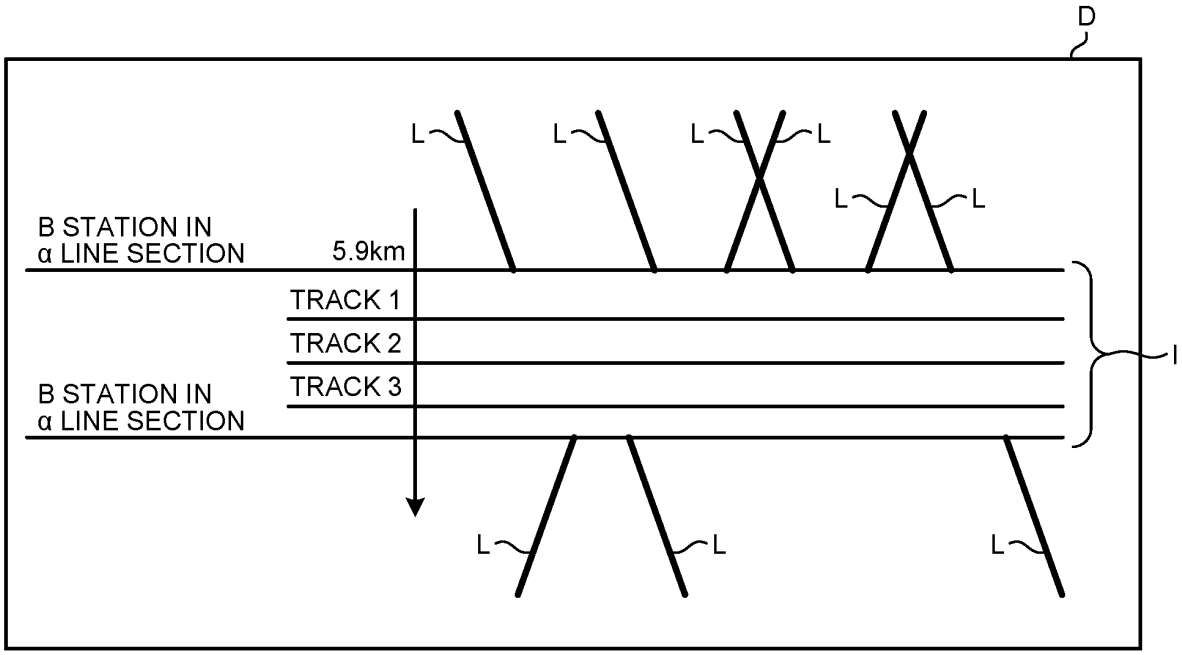

D
L
L
L
L
L
L
B STATION IN α LINE SECTION
5.9km
TRACK 1
TRACK 2
TRACK 3
B STATION IN α LINE SECTION
I
L
L
L

FIG.8

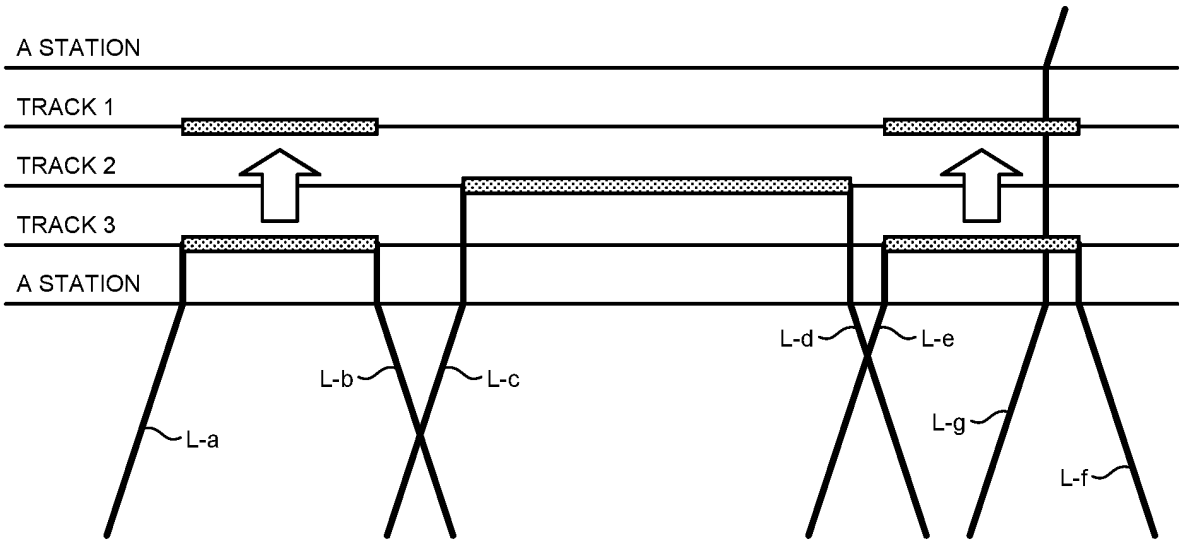


FIG.9

	FORM	OPERATION DIRECTION	TRAIN CLASSIFI-CATION	REGULAR/ IRREGULAR	TRAVEL CLASSIFI-CATION	CONSTRUC-TION	PRIORITY
TRACK 1	A COMPANY	**FOR X STATION**	**LOCAL**	**REGULAR**	**NORMAL**		
TRACK 2		FOR X STATION	LOCAL	REGULAR	NORMAL		
TRACK 3		FOR X STATION	LIMITED EXPRESS	REGULAR	NORMAL		

FIG.10

	FORM	OPERATION DIRECTION	TRAIN CLASSIFI-CATION	REGULAR/ IRREGULAR	TRAVEL CLASSIFI-CATION
LINE a		FOR A STATION	LOCAL	REGULAR	NORMAL
LINE b		**FOR X STATION**	**LOCAL**	**REGULAR**	**NORMAL**

FIG.11

TRACK OF PRECEDING TRAIN	TRACK OF SUCCEEDING TRAIN	DEPARTURE -ARRIVAL	PASSING-ARRIVAL	DEPARTURE -PASSING	PASSING-PASSING (ARRIVAL SIDE)	ARRIVAL-DEPARTURE	PASSING-DEPARTURE	ARRIVAL-PASSING	PASSING-PASSING (DEPARTURE SIDE)
TRACK 2	TRACK 1	**01:00**	01:00			01:30	**01:00**		
TRACK 2	TRACK 2	01:30	01:30			01:30	01:30		
TRACK 2	TRACK 3	01:30	01:30			01:30	01:00		

FIG.12

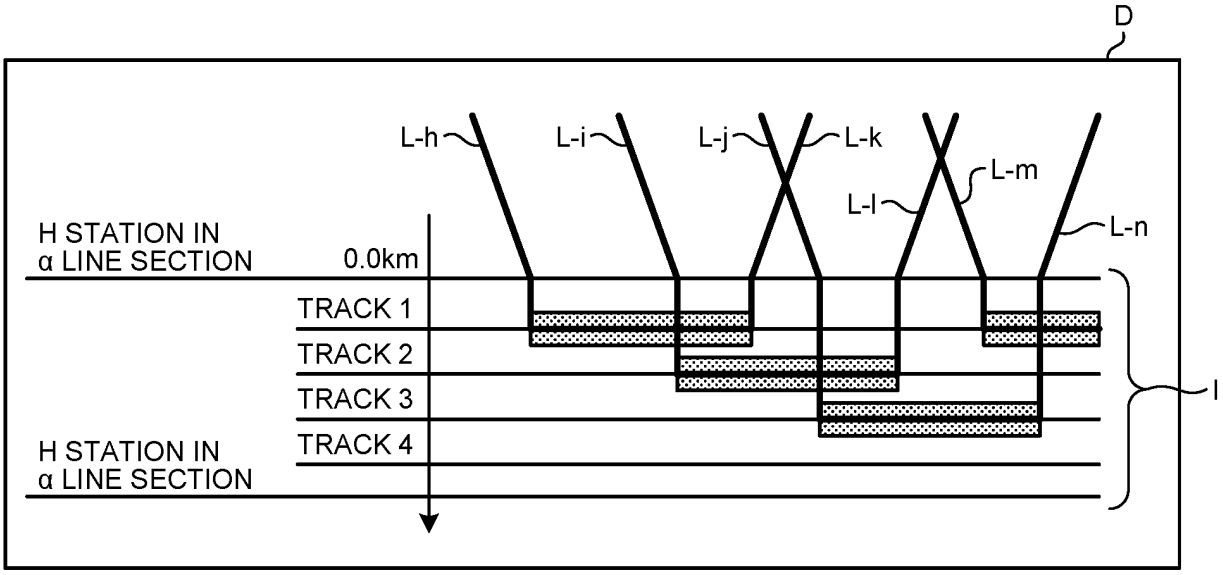

D
L-h
L-i
L-j
L-k
L-m
L-l
L-n
H STATION IN
α LINE SECTION
0.0km
TRACK 1
TRACK 2
TRACK 3
TRACK 4
H STATION IN
α LINE SECTION
I

FIG.13

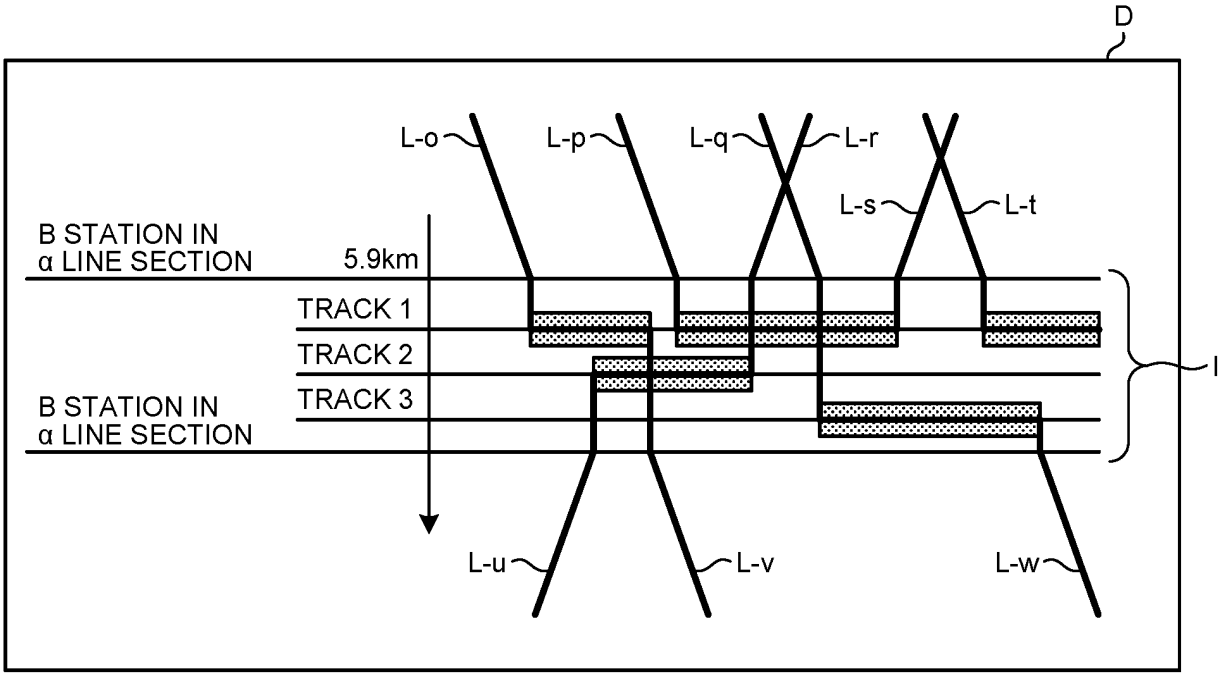

D
L-o
L-p
L-q
L-r
L-s
L-t
B STATION IN
α LINE SECTION
5.9km
TRACK 1
TRACK 2
TRACK 3
B STATION IN
α LINE SECTION
I
L-u
L-v
L-w

FIG.14

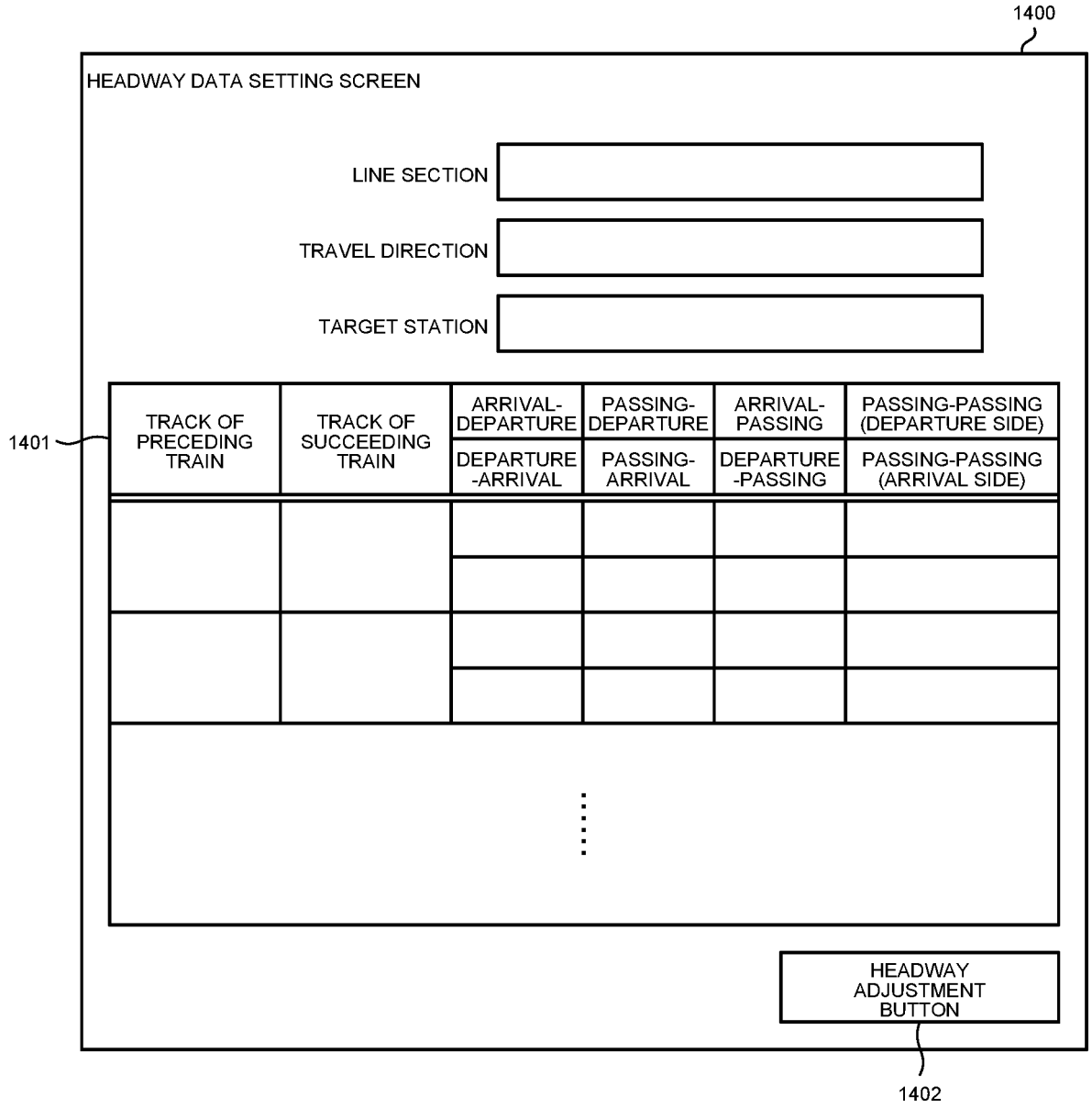

1400
HEADWAY DATA SETTING SCREEN
LINE SECTION
TRAVEL DIRECTION
TARGET STATION
1401
TRACK OF PRECEDING TRAIN
TRACK OF SUCCEEDING TRAIN
ARRIVAL-DEPARTURE
PASSING-DEPARTURE
ARRIVAL-PASSING
PASSING-PASSING (DEPARTURE SIDE)
DEPARTURE-ARRIVAL
PASSING-ARRIVAL
DEPARTURE-PASSING
PASSING-PASSING (ARRIVAL SIDE)
HEADWAY ADJUSTMENT BUTTON
1402

FIG.15

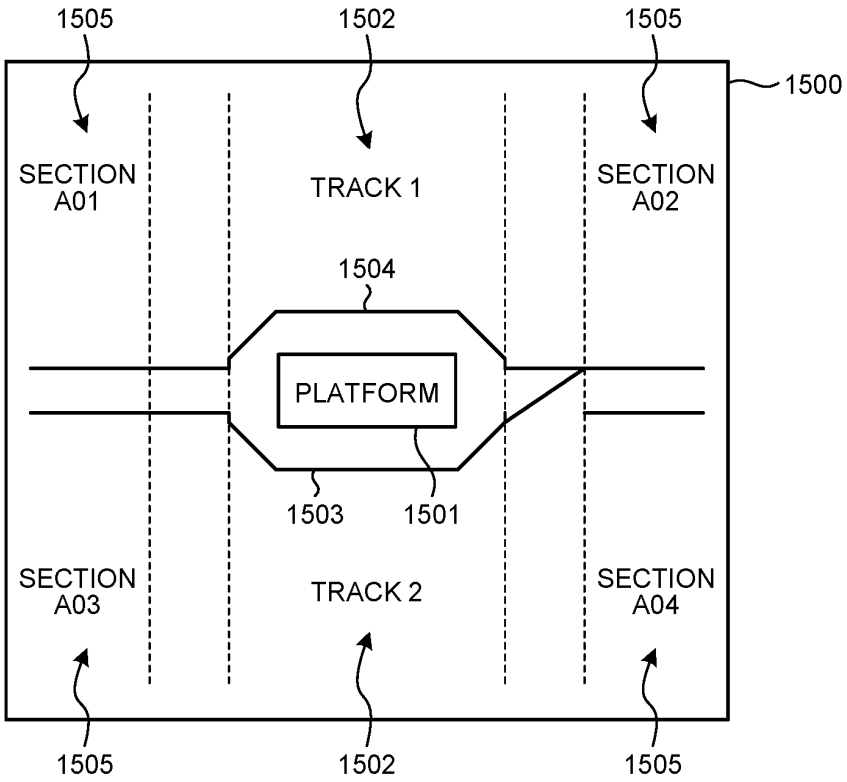

1505
1502
1505
1500
SECTION A01
TRACK 1
SECTION A02
1504
PLATFORM
1503
1501
SECTION A03
TRACK 2
SECTION A04
1505
1502
1505

FIG.16

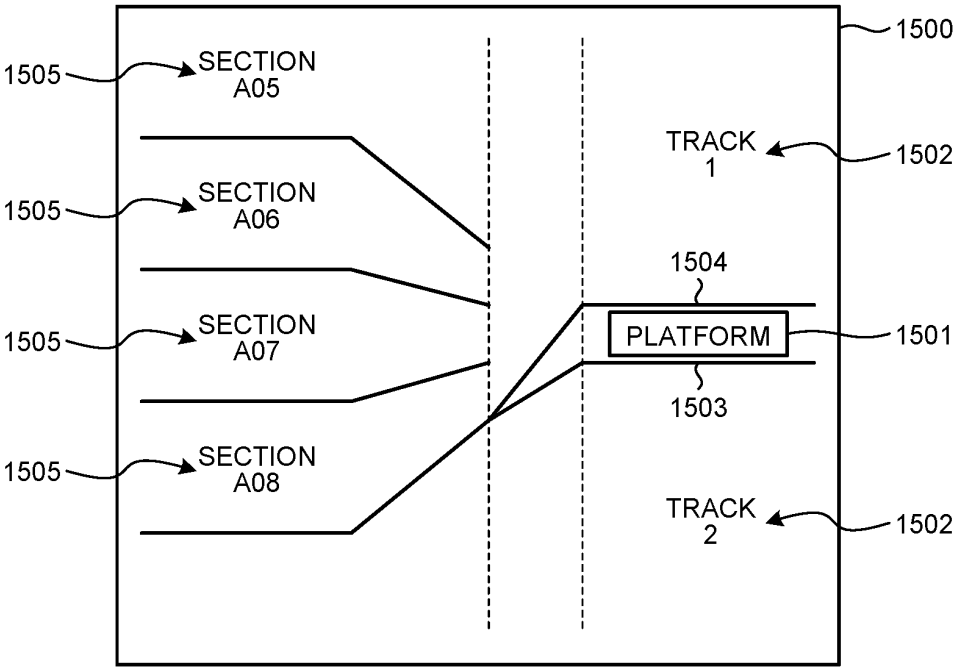

1500
1505
SECTION A05
TRACK 1
1502
1505
SECTION A06
1504
1505
SECTION A07
PLATFORM
1501
1503
1505
SECTION A08
TRACK 2
1502

FIG.17

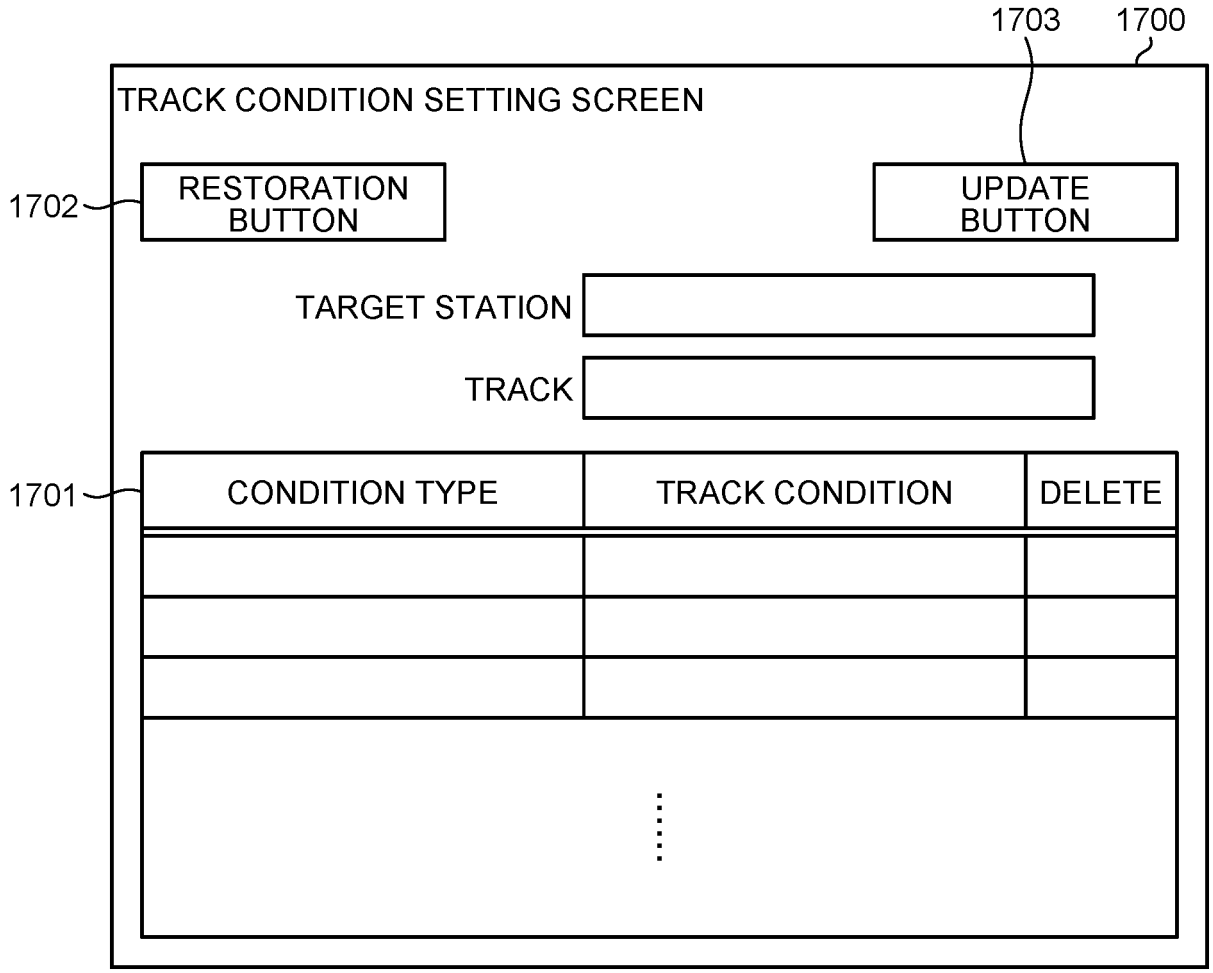

1703
1700
TRACK CONDITION SETTING SCREEN
1702
RESTORATION BUTTON
UPDATE BUTTON
TARGET STATION
TRACK
1701
CONDITION TYPE
TRACK CONDITION
DELETE

FIG.18

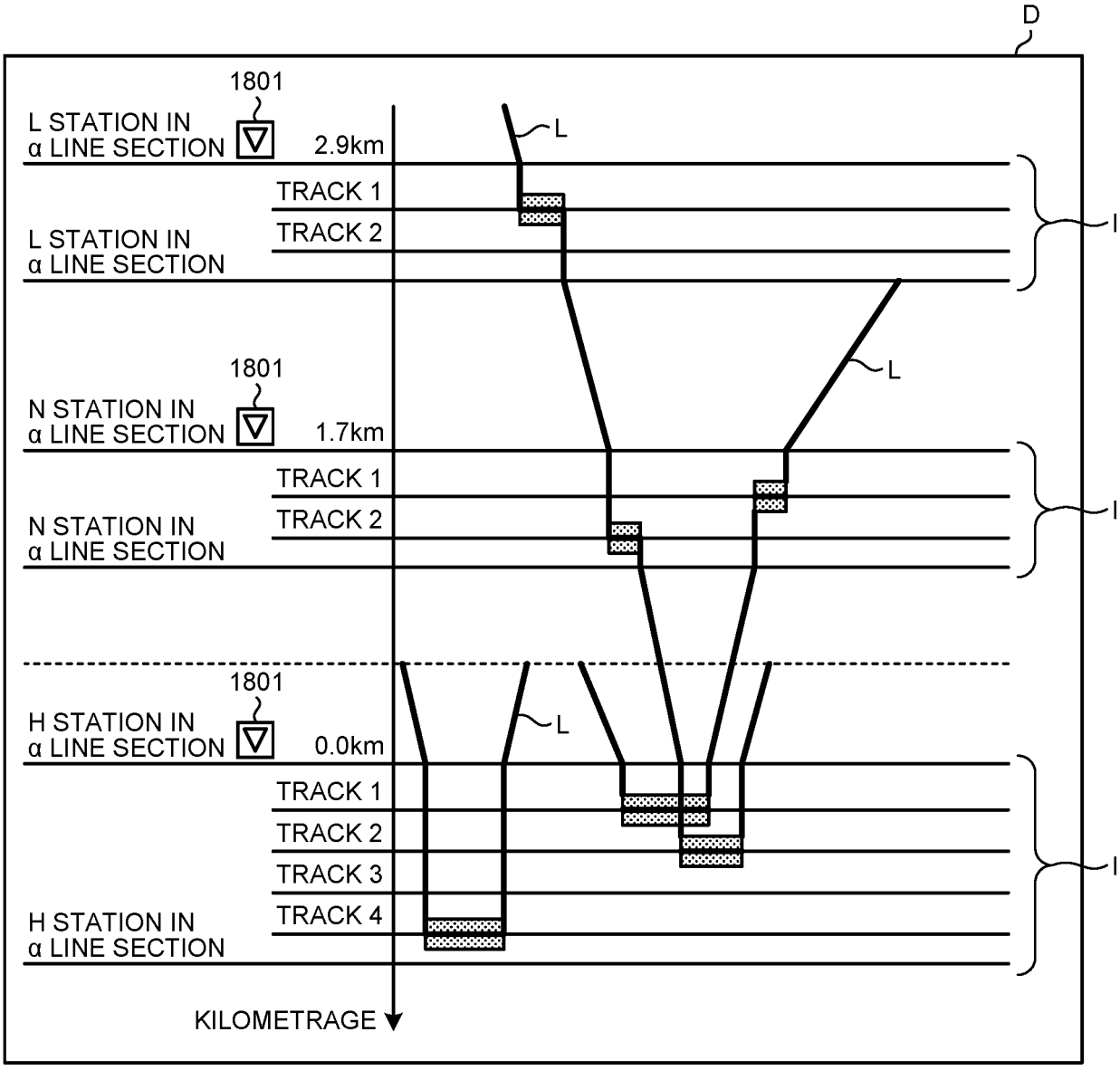
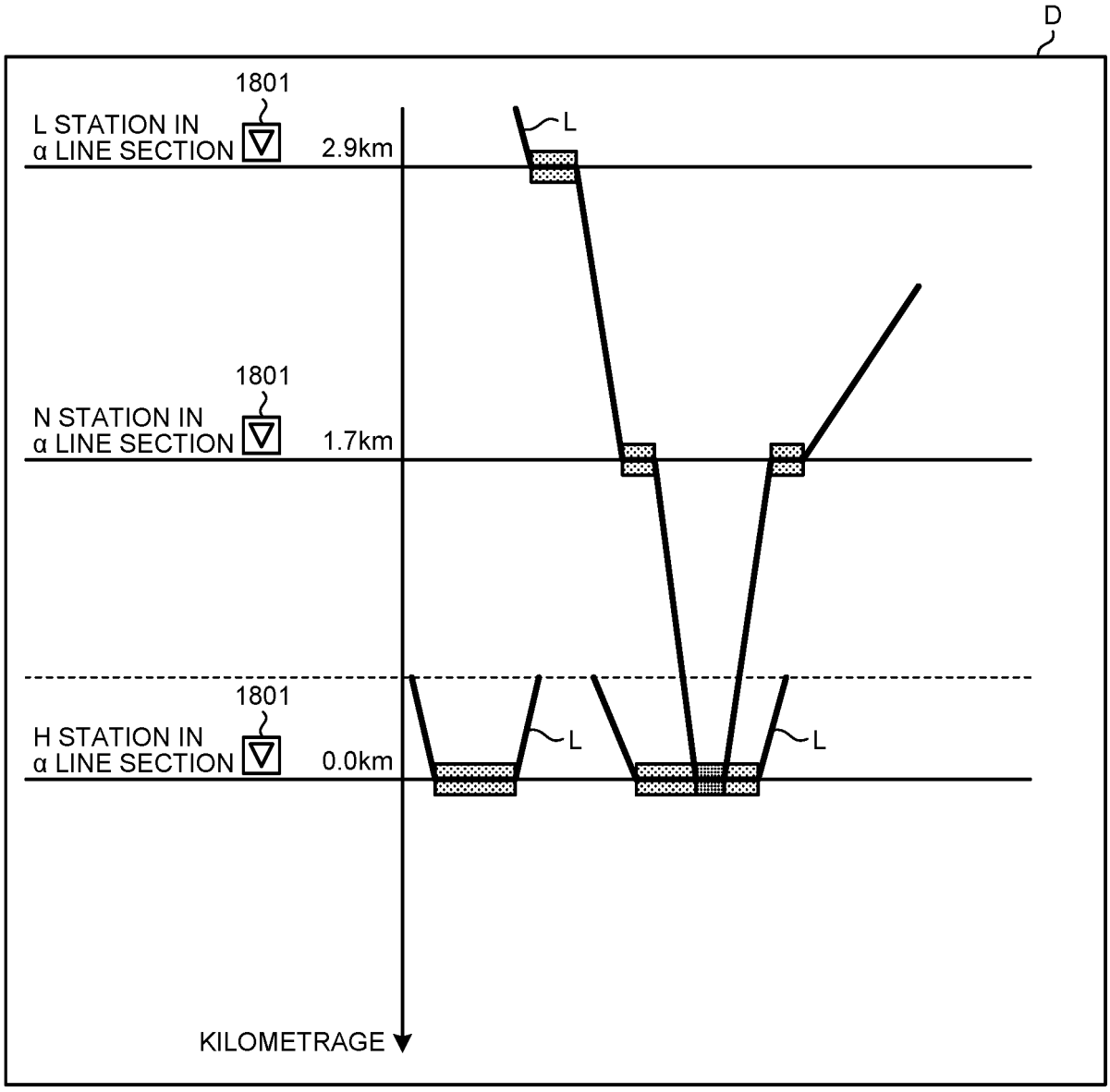

D
1801
L STATION IN
α LINE SECTION
2.9km
L
TRACK 1
TRACK 2
L STATION IN
α LINE SECTION
I
1801
N STATION IN
α LINE SECTION
1.7km
L
TRACK 1
TRACK 2
N STATION IN
α LINE SECTION
I
1801
H STATION IN
α LINE SECTION
0.0km
L
TRACK 1
TRACK 2
TRACK 3
TRACK 4
H STATION IN
α LINE SECTION
I
KILOMETRAGE

FIG.19


D
1801
L STATION IN
α LINE SECTION
2.9km
L
1801
N STATION IN
α LINE SECTION
1.7km
1801
H STATION IN
α LINE SECTION
0.0km
L
L
KILOMETRAGE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/015915

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. 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)
Int. Cl. B61L27/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2019
Registered utility model specifications of Japan 1996-2019
Published registered utility model applications of Japan 1994-2019

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.
X A	WO 2016/175134 A1 (HITACHI, LTD.) 03 November 2016, paragraphs [0100]-[0105], fig. 9, 10 & EP 3290290 A1, paragraphs [0100]-[0105]	8 1-7
A	JP 4-151374 A (MITSUBISHI ELECTRIC CORP.) 25 May 1992, entire text, all drawings (Family: none)	1-8
A	JP 9-123914 A (HITACHI, LTD.) 13 May 1997, entire text, all drawings (Family: none)	1-8
A	JP 2011-255802 A (HITACHI, LTD.) 22 December 2011, entire text, all drawings (Family: none)	1-8

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13.06.2019	25.06.2019
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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Patent documents cited in the description

- JP H752801 B **[0003]**