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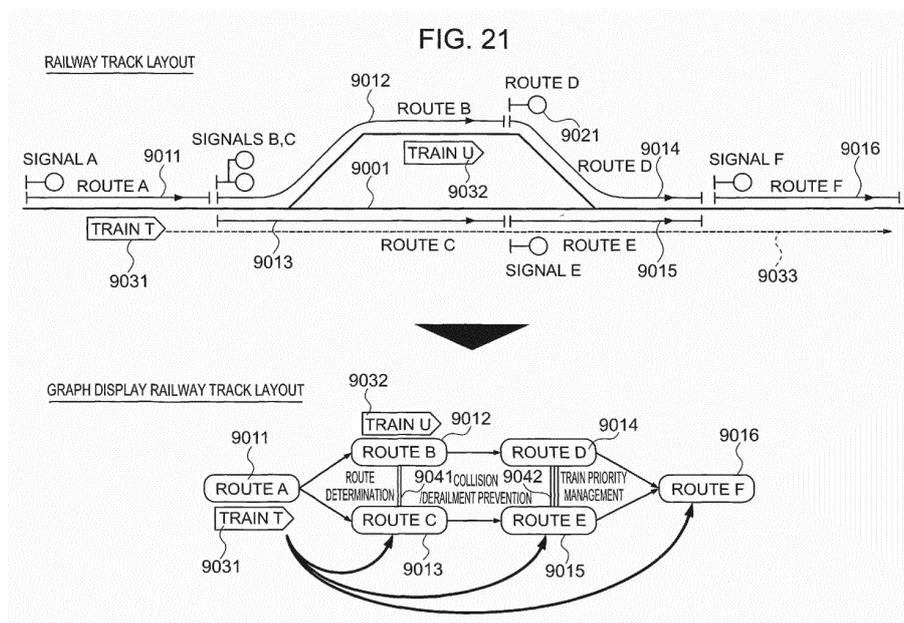
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(54) **ROUTE CONTROL PROGRAM GENERATION METHOD AND ROUTE CONTROL DEVICE**

(57) The present invention is a route setting device of a railway operation management system, and a method for generating a route setting program. The route setting program is generated by defining three control principles of route determination, collision/derailment prevention, and train priority management as the control principles of the route setting device, previously imple-

menting, as program modules, route setting logics for implementing the respective control principles, extracting geometric patterns between two routes from a track layout, associating the geometric patterns with the route setting logics, and combining the program modules in which the route setting logics are implemented according to the association.



Description

INCORPORATION BY REFERENCE

[0001] The present application claims priority from Japanese patent application JP2011-164928 filed on July 28, 2011, the contents of which are hereby incorporated by reference into this application.

TECHNICAL FIELD

[0002] The present invention relates to a technology for controlling an object moving on a track and relates to, for example, automatic route setting (ARS) of a railway traffic management system (TMS).

BACKGROUND ART

[0003] Train operation management has changed from the conventional signal control by a station employee to the automatic-signal control according to the railway traffic management system with development of computer control. The railway traffic management system has been developed by automating the conventional station employee work by a computer, and the control of the signal is performed for each station which is a management unit of the station employee work. In the railway traffic management system, control of the signal is controlled by the route setting device.

[0004] Here, Patent Literature 1 discloses a technology by which an electronic interlocking system, which is a sub-system of a railway traffic management system, checks the rationality which can be performed in one route unit from a track layout and an interlocking table and generates an interlocking database which can be used by the electronic interlocking system. Incidentally, the electronic interlocking system is a system which is a kind of railway safety equipment and controls a signal and a point which are mutually in interlocking relation according to an interlocking logic.

CITATION LIST

PATENT LITERATURE

[0005] Patent Literature 1: JP-A-06-321107

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0006] The route setting device requires configuration of a program depending on a track layout of a station, but since the track layout of the station is various, unique programs are now being developed for individual track sections and stations. And, the program must be modified when the track layout is renovated. But, the program is becoming large because the track layout has become

complex and the control has been sophisticated in these years, and it is becoming difficult to secure human resources by a method of configuring a unique program for each track section or station. As a result, there are caused degradation of program quality, lengthening of development and an increase in cost.

[0007] Therefore, there is a request for a method capable of developing a route setting device and its program by a common method even if a track section and a station have a different track layout.

SOLUTION TO PROBLEM

[0008] A method for generation of a route setting program which issues a control command to trackside facilities to perform the route setting of trains by a route setting program generation device, the method comprising:

a step of accepting track layout information on a railway that is comprised of a plurality of routes,
 a step of defining a geometrical relation between the two routes of each of the plurality of routes for each of combinations of two routes comprising the other one route configuring the track layout by using one of a predetermined plurality of geometric pattern types,
 a step of selecting a logic, which is used for judgment of enterable or not of a train into one of the two routes for each of the combinations of the two routes, based on a geometric pattern type defined for the combinations of the two routes, and
 a step of generating the route setting program by connecting a plurality of program modules identified by the selected plurality of logics.

[0009] And, a train route setting device for performing train route setting by issuing a control command to trackside facilities, the train route setting device comprising:

route information which registers, for each of a plurality of routes configuring a railway, a geometrical relation between the route and each of one or more other routes configuring the said railway,
 identification information of two routes configuring the geometrical relation for each geometrical relation, and geometric information which has registered a geometric pattern type showing to which of a predetermined plurality of geometric pattern types the geometrical relation is classified, and a route setting logic selected for the geometrical relation based on the geometric pattern type, and
 a route reservation management portion which judges enterable or not of the train into a route to be processed, wherein:

the route reservation management portion:
 specifies one or more geometrical relations between the route to be processed and one or more

other routes for the route to be processed according to the route information, and judges enterable or not of a train into the route to be processed for each specified geometrical relation on the basis of an on-rail state or an entry schedule of a train into another route configuring the geometrical relation by using the route setting logic registered for the geometrical relation.

ADVANTAGEOUS EFFECTS OF INVENTION

[0010] According to one example of the embodiment of the present invention, a route setting device can be developed to have a common method even if the track section and the station have a different track layout, and it becomes possible to develop easily a route setting program and a route setting device according to a track shape. And, according to one example of the embodiment, a program module used for generation of the route setting program can be reused for a variety of route setting devices, so that it becomes possible to reduce a development man-hour, a development period and a development cost by improvement of reusability. In addition, according to one example of the embodiment, improvement of quality can be realized by incorporating the same program module into a various types of products and testing. In addition, according to one example of the embodiment, when the program module is updated, it becomes possible to reflect easily to a large number of route setting program groups, and bug fixing and an advanced additional function can be applied quickly to route setting device product groups.

[0011] Other objects, features and advantages of the present invention will become apparent from the following description of the present invention related to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

[FIG. 1A] A hardware configuration example of a route setting program generation device.
 [FIG. 1B] A software configuration example of the route setting program generation device.
 [FIG. 2A] An example of a track shape information table which is possessed by the route setting program generation device.
 [FIG. 2B] An example of a route shape information table which is possessed by the route setting program generation device.
 [FIG. 2C] An example of a geometric pattern storage table which is possessed by the route setting program generation device.
 [FIG. 2D] An example of a selected route setting logic storage table which is possessed by the route setting program generation device.

[FIG. 2E] An example of a geometric pattern decision table which is possessed by the route setting program generation device.
 [FIG. 3A] A schematic view of a geometric pattern type "crossing A".
 [FIG. 3B] A schematic view of a geometric pattern type "crossing B".
 [FIG. 3C] A schematic view of a geometric pattern type "start point blockade A".
 [FIG. 3D] A schematic view of a geometric pattern type "start point blockade B".
 [FIG. 3E] A schematic view of a geometric pattern type "end point blockade A".
 [FIG. 3F] A schematic view of a geometric pattern type "end point blockade B".
 [FIG. 3G] A schematic view of a geometric pattern type "start-end alternate point blockade".
 [FIG. 3H] A schematic view of a geometric pattern type "deadlock B".
 [FIG. 3I] A schematic view of a geometric pattern type "both end point blockage C".
 [FIG. 3J] A schematic view of a geometric pattern type "start-end point blockage A".
 [FIG. 3K] A schematic view of a geometric pattern type "start-end point blockage B".
 [FIG. 3L] A schematic view of a geometric pattern type "forward direction connection".
 [FIG. 3M] A schematic view of a geometric pattern type "reverse direction connection A".
 [FIG. 3N] A schematic view of a geometric pattern type "reverse direction connection B".
 [FIG. 3O] A schematic view of a geometric pattern type "reverse direction connection C".
 [FIG. 3P] A schematic view of a geometric pattern type "route selection A".
 [FIG. 3Q] A schematic view of a geometric pattern type "route selection B".
 [FIG. 3R] A schematic view of a geometric pattern type "route selection C".
 [FIG. 3S] A schematic view of a geometric pattern type "both end point blockage A".
 [FIG. 3T] A schematic view of a geometric pattern type "both end point blockage B".
 [FIG. 3U] A schematic view of a geometric pattern type "start-end point blockage C".
 [FIG. 3V] A schematic view of a geometric pattern type "deadlock A".
 [FIG. 4A] An example of a geometric pattern-route setting logic type correspondence slip which is possessed by the route setting program generation device.
 [FIG. 4B] An example of a route setting logic index table which is possessed by the route setting program generation device.
 [FIG. 5] An example of an entire processing flow of the route setting program generation device.
 [FIG. 6] An example of a processing flow per-

- formed by a track layout input portion of the route setting program generation device.
- [FIG. 7] A screen example shown when track layout information is accepted by the route setting program generation device.
- [FIG. 8] An example of an error display screen shown by the track layout input portion of the route setting program generation device.
- [FIG. 9] An example of a processing flow performed by a geometric pattern extracting portion of the route setting program generation device.
- [FIG. 10] A screen example shown by the geometric pattern extracting portion of the route setting program generation device.
- [FIG. 11] An example of an error display shown by the geometric pattern extracting portion of the route setting program generation device.
- [FIG. 12] An example of a processing flow performed by a route setting logic selection portion of the route setting program generation device.
- [FIG. 13] A screen example shown by the route setting logic selection portion of the route setting program generation device.
- [FIG. 14A] A software configuration example of a route setting program generated by the route setting program generation device.
- [FIG. 14B] A configuration example of a reservation processing intermediate data storage table used by the route setting program generated by the route setting program generation device.
- [FIG. 14C] A configuration example of a geometric information table used by the route setting program generated by the route setting program generation device.
- [FIG. 14D] A configuration example of a route information table used by the route setting program generated by the route setting program generation device.
- [FIG. 14E] A configuration example of a route state table used by the route setting program generated by the route setting program generation device.
- [FIG. 14F] A configuration example of a route entering train table used by the route setting program generated by the route setting program generation device.
- [FIG. 14G] A configuration example of a timetable used by the route setting program generated by the route setting program generation device.
- [FIG. 14H] An example of a processing flow performed by a program module connection
- portion of the route setting program generation device.
- [FIG. 15] An example of a whole processing flow of the route setting program generated by the route setting program generation device.
- [FIG. 16] An example of a detailed processing flow of a part (processing 1523) of the processing flow of the route setting program generated by the route setting program generation device.
- [FIG. 17] An example of a detailed processing flow of a part (processing 1525) of the processing flow of the route setting program generated by the route setting program generation device.
- [FIG. 18] An example of a detailed processing flow of a part (processing 1526) of the processing flow of the route setting program generated by the route setting program generation device.
- [FIG. 19] An example of a screen provided by the route setting program.
- [FIG. 20] An entire configuration example of a railway traffic management system.
- [FIG. 21] A diagram exemplifying an operation outline of the route setting program generated by the route setting program generation device.

DESCRIPTION OF EMBODIMENTS

[0013] One embodiment of the present invention will be described below in detail referring to FIG 1 to FIG 21.

[0014] FIG 20 is an entire system configuration example of a railway traffic management system which manages the train operation while monitoring a train operation plan, an on-rail position of the train and a facility state of a signal, a point, etc. and which is comprised of a route setting device 9900, a plan type system 9910, a ground device 9920, a train 9930, a group of trackside facilities 9940 (a track circuit 9941, a signal 9942 and a point 9943 only are shown in the drawing).

[0015] The route setting device 9900 receives, over a network, timetable information determined by the plan type system 9910 and a state of the trackside facilities 9940 collected by the trackside facilities 9920 and holds them therein, and refers to an on-rail position of the train 9930 obtained from the track circuit 9941 and a departure time and a plan route described in the timetable information and controls the signal 9942 and the point 9943 disposed on the train path for the train 9930 via the ground device 9940. A route setting program generation device 100 described later generates a program for operating the route setting device 9900.

[0016] The plan type system 9910 is a system supporting the creation of plans related to the train operation, such as a timetable, a vehicle operation plan, an inspection and maintenance plan, etc., and connected to the

route setting device 9900 via a network.

[0017] The ground device 9940 is connected to the route setting device 9900 via a network, and performs the reverse control of the signal 9942 and the point 9943 in response to a control request from the route setting device 9900. And, the states of the signal 9942 and the point 9943 (normal/reverse) and the state of the track circuit 9941 (occupied/free) are monitored, and the results are transmitted to the route setting device 9900.

[0018] The train 9930 has therein safety devices such as ATS (Automatic Train Stop) and ATC (Automatic Train Control) for performing an automatic stop and automatic control of the train, and an onboard device such as an information management system for collecting, showing and recording detailed operation states and failure information on the vehicle. And, information possessed by the onboard device can be transmitted to the ground device 9920 via digital radio. In this embodiment, it is assumed that the on-rail position of the train 9930 is determined according to the state of the track circuit 9941, but the on-rail position of the train 9930 may be determined by calculating or measuring the position of the own train by, for example, the onboard device, and transmitting to the ground device via digital radio.

[0019] FIG 21 is an operation concept diagram of a route setting program 1400 (FIG 14A) which is a program for operating the route setting device 9900 generated by the route setting program generation device 100.

[0020] The route setting program 1400 is a program which uses the plan information received from the plan type system 9910 and the trackside facilities information received from the ground device 9920 to perform determination of signal control, and requests the ground device 9920 for control of a proceed indication of the signal. The route setting program 1400 controls a railway 9901 as a set of routes. Here, the route is a protection section of the signal and indicates a railway area from a first inward track circuit provided in a section inward of the signal to a final inward track circuit. The railway shown in FIG 21 includes a route A 9011, a route B 9012, a route C 9013, a route D 9014, a route E 9015, and a route F 9016. The device which instructs permission for entry of a train into a route is a signal, and, for example, the permission for entry of a train into the route is instructed by indicating (a proceed indication) a blue signal, and non-permission for entry of a train into the route is instructed by indicating a red signal (a stop indication). In FIG. 21, for example, when a signal D 9021 is a proceed indication, a train U 9032 can enter the route D 9014, but when the signal D 9021 is a stop indication, the train U 9032 cannot enter the route D 9014.

[0021] The route setting program 1400 realizes the signal control by using a method of route reservation by a train. Here, the reservation of the route by the train means that when a train next entering the route is the relevant train, decision is made by the route setting device 9900. When the route is reserved, the route setting device 9900 makes a proceed indication request to the ground device

9920 for a signal which has the relevant route determined as a protection section. Reservation of the route is started with the route where the train exists determined as a starting point, and it is performed sequentially from a route near the relevant train along the route of the train. In FIG 21, for example, reservation processing started with a train T 9031 determined as a starting point is performed in order of the route C 9013, the route E 9015, the route F 9016 along a route 9033. The reservation processing is terminated when it fails, and, for example, if the reservation of the route E 9015 fails in the above example, the route F 9016 and following are not reserved.

[0022] The route setting program 1400 defines three of route determination, train priority management, and collision/derailment prevention as control principles of the route setting device, and a route setting logic, which is a logic for realizing the respective control principles, is associated with the geometric pattern type (described later) which is defined between two routes. At the time when a route is reserved, the route setting logic associated with the geometric pattern type possessed by the relevant route is performed. In FIG 21, for example, when the route B 9012 and the route C 9013 which are routes having a geometric pattern 9041 are reserved, the route setting logic corresponding to route determination is performed, when the route D 9014 and the route E 9015 which are routes having a geometric pattern 9042 are reserved, the route setting logic corresponding to train priority management is performed, and when the route B 9012, the route C 9013, the route D 9014, and the route E 9015 which are routes having the geometric pattern 9041 or the geometric pattern 9042 are reserved, the route setting logic corresponding to collision/derailment prevention is performed.

[0023] FIG 1A is a hardware configuration example of the route setting program generation device 100. Hardware for the route setting program generation device 100 is comprised of a central processing unit 110, a main storage device 120, an internal bus 130, a bus interface 140, an external bus 150, an input/output device 160, an input/output device interface 161, a mass-storage device 170, a mass-storage device interface 171, a communication device 180, and a communication device interface 181.

[0024] The central processing unit 110 is a processor for performing operations such as program execution. The main storage device 120 is used as a processing region at the time of program execution and a temporary storage region for data used for transmission/reception with the plan type system 9910 and the ground device 9920, and stores, for example, a basic program or basic data such as OS (Operating System). Besides, when a program is executed, the main storage device 120 stores temporarily programs for realizing a track layout input portion 211, a geometric pattern extracting portion 212, a route setting logic selection portion 213, a program module connection portion 214, a controller portion 220, a screen management portion 230, an input interface

241, and an output interface 242. The central processing unit 110 and the main storage device 120 are connected by the internal bus 130, and the internal bus 130 is connected to the external bus 150 via the bus interface 140.

[0025] The input/output device 160 includes interface devices with the user, such as a display, a keyboard, a mouse, etc., and a drive device capable of reading from and writing into an external medium, etc. The user can control the execution of a program by using the input devices such as a keyboard and a mouse.

[0026] The mass-storage device 170 is a device such as, for example, HDD (Hard Disk Drive) and can store permanently the basic program, the processed results, programs, etc. for realizing the track layout input portion 211, the geometric pattern extracting portion 212, the route setting logic selection portion 213, the program module connection portion 214, the controller portion 220, the screen management portion 230, the input interface 241, and the output interface 242. When various types of processing are performed, the central processing unit 110 reads programs into the main storage device 120 and performs. And, various types of data such as a track shape table 251, a route shape information table 252, a geometric pattern storage table 253, a geometric pattern decision table 254, a selected route setting logic storage table 255, a geometric pattern-route setting logic type correspondence table 300, a route setting logic index table 400, a route setting logic library 256, and a railway traffic management core module library 257 are stored.

[0027] The communication device 180 is a device for connection with, for example, an external server device such as Ethernet (registered trade-mark) and can provide a program generated by the route setting program generation device 100 to the external server device through the network. It is made possible by using the communication device 180 to provide, for example, a function of the route setting program generation device 100 to a computer connected to the network as a service.

[0028] The input/output device 160, the mass-storage device 170 and the communication device 180 each are connected to the external bus 150 through the input/output device interface 161, the mass-storage device interface 171 and the communication device interface 181. The configuration including the input/output device 160, the mass-storage device 170, and the communication device 180 may be determined as the route setting device 100.

[0029] The route setting device 9900 also has a hardware configuration which is similar to the hardware configuration example shown in FIG. 1A. Main differences from the route setting program generation device 100 are software and data stored in the main storage device 120 and the mass-storage device 170, and they are described later referring to FIG 14A.

[0030] FIG 1B is a software configuration example of the route setting program generation device 100. Software of the route setting program generation device 100

is composed of the track layout input portion 211, the geometric pattern extracting portion 212, the route setting logic selection portion 213, the program module connection portion 214, the controller portion 220, the screen management portion 230, the input interface 241, the output interface 242, the track shape table 251, the route shape information table 252, the geometric pattern storage table 253, the geometric pattern decision table 254, the selected route setting logic storage table 255, the geometric pattern-route setting logic type correspondence table 300, the route setting logic index table 400, the route setting logic library 256, and the railway traffic management core module library 257.

[0031] Programs for realizing the track layout input portion 211, the geometric pattern extracting portion 212, the route setting logic selection portion 213, the program module connection portion 214, the controller portion 220, the screen management portion 230 and the input interface 241 and also the output interface 242, the geometric pattern decision table 254, the route setting logic index table 256, the route setting logic library 257, and the railway traffic management core module library 258 are developed from the mass-storage device 170 to the main storage device 120 when they are executed, and computing is performed by the central processing unit 110. And, the track shape table 251, the route shape information table 252, the geometric pattern storage table 253 and the selected route setting logic storage table 255 generated by the execution of the program are developed in the main storage device 120. The user can control the execution of the program by giving instructions to the input interface 241 through the input/output device 160 such as a keyboard, a mouse, a display, etc. And, data input/output can be performed by using a removable and portable storage medium as the input/output device 160. Input/output can also be performed with another device through the communication device 180. The program realizing the respective function portions may be stored previously in the mass-storage device 170 or may be introduced into the mass-storage device 170 and the main storage device 120 from another device through a usable medium. The medium denotes, for example, a removable storage medium as the input/output device 160 or a communication medium such as a network, or a carrier wave or a digital signal transmitted through the network as the communication device 180.

[0032] The track layout input portion 211 is a portion which receives input information on the track layout and the route from the user through the input interface 241 and registers in the track shape information table 251 and the route shape information table 252.

[0033] The geometric pattern extracting portion 212 is a portion which discriminates a geometric pattern type between two routes by using the track shape information table 251, the route shape information table 252 and the geometric pattern decision table 254, and stores the results into the geometric pattern storage table 253.

[0034] The route setting logic selection portion 213 is

a portion which selects a selectable route setting logic by using the geometric pattern storage table 253, the geometric pattern-route setting logic type correspondence table and the route setting logic index table 400, shows on the display through the output interface, receives from the user a route setting logic, which is performed for each of geometric patterns, through the input interface 241, and registers in the selected route setting logic storage table 255.

[0035] The program module connection portion 214 is a portion which generates a program for operating the route setting device 9900 from the track shape information table 251, the route shape information table 252, the geometric pattern storage table 253, the selected route setting logic storage table 255, the route setting logic index table, the route setting logic library 256, and the railway traffic management core module library 257.

[0036] The track shape table 251, the route shape information table 252, the geometric pattern storage table 253, the geometric pattern decision table 254, the selected route setting logic storage table 255, the geometric pattern-route setting logic type correspondence table 300, and the route setting logic index table 400 are described later referring to a configuration example.

[0037] The route setting logic library 256 is a library storing a large number of route setting logic modules. Here, the route setting logic modules are uniquely determined by giving a route setting logic ID which is a key for uniquely identifying the route setting logic modules.

[0038] The railway traffic management core module library 257 is a library storing modules other than the route setting logic modules among the modules required for generating the program which operates the route setting device 9900, and stores modules which realize, for example, a communication management portion 1460, an input interface 1471, an output interface 1472, a plan type system information management portion 1415, a timetable 1487, a trackside facilities information management portion 1452, a facility state 1488, a route reservation management portion 1410, a reservation processing intermediate data storage table 1481, a route state table 1484, a route entering train table 1485 of the route setting program 1400.

[0039] The controller portion 220 is a portion which receives input information from the user via the screen management portion 230, and controls the track layout input portion 211, the geometric pattern extracting portion 212, the route setting logic selection portion 213, and the program module connection portion 214. The screen management portion 230 is a portion which receives input information from the user through the input interface 241, and delivers to a controller portion 421. And, it is a portion which receives the processed results of the track layout input portion 211, the geometric pattern extracting portion 212, the route setting logic selection portion 213 and the program module connection portion 214 and delivers the screen output to the output interface 242. The input interface 241 is a portion which receives input in-

formation from the user, and delivers to the screen management portion 230. The output interface 242 is a portion which outputs the screen output received from the screen management portion to the user interface such as a display.

[0040] FIG 2 shows one example of various tables used by the route setting program generation device 100.

[0041] FIG 2A is one example of the track shape table 251 and has a railway element ID, a station name, start coordinates, and end coordinates as elements. The railway element ID stores a key for uniquely discriminating a line segment which shows the input railway in a track layout input window 730 shown in FIG 7. The station name stores a station name to which a relevant line segment belongs. The start coordinates and the end coordinates each store the coordinate values of two end points, which the relevant line segment has, in the track layout input window 730 shown in FIG 7.

[0042] FIG 2B is one example of the route shape table 252, and has a route ID, start point coordinates, end point coordinates, a corresponding railway element ID, a direction, and a neighboring station border as elements. The route ID stores a key for uniquely discriminating a route input to the track layout input window 730. The start point coordinates and the end point coordinates store coordinate values of the start point and the end point of the respective relevant routes which are in the track layout input window 730. Here, the start point indicates a place where the relevant train passes last outside the relevant route when the train enters the route, and the end point indicates a place where the relevant train passes last within the relevant route when the train proceeds from the route. For example, in the track layout input window 730 shown in FIG 7, 735 is a start point of a route 733, and 736 is an end point of the route 733. Incidentally, 735 is the start point of the route 733, but the railway position indicated by 735 is not included in the route 733. And, 736 is also a start point of a route 734. On the track layout input window 730, the corresponding railway element ID stores the value of the railway element ID in the track shape table 251 for all of line segments which are included in the relevant route. For example, the line segments included in the route 733 are line segments 737, 738 and 739 on the track layout input window 730 shown in FIG 7. The direction stores a direction of the relevant route. Here, the direction of the route is comprised of, for example, two values of up and down.

[0043] FIG 2C is one example of the geometric pattern storage table 253 and has a geometric pattern ID, a geometric pattern type, a route 1 ID, and a route 2 ID as elements. The geometric pattern ID stores a key for uniquely discriminating a combination of two routes and a geometrical relation (hereinafter, the geometrical relation is also called "geometric pattern") between the two relevant routes. The geometric pattern type stores types of geometric patterns showing that the relevant geometric patterns are classified into which of the previously defined 22 geometric pattern types (the geometric pat-

tern types are described later referring to FIG 3). The route 1 ID and the route 2 ID store the value of route ID of the relevant route, which is defined in the route shape table 252 in order to specify two routes configuring the relevant geometric pattern.

[0044] FIG 2D is an example of the selected route setting logic storage table 255 and has a geometric pattern ID, a reservation target route selection logic, a train priority determination logic, a route check logic (route 1→route 2), and a route check logic (route 2→route 1) as elements. The geometric pattern ID is identical to the geometric pattern ID of the geometric pattern storage table 253. The reservation target route selection logic, the train priority determination logic, the route check logic (route 1→route 2), and the route check logic (route 2→route 1) each store route setting logic IDs each corresponding to the reservation target route selection logic, the train priority determination logic, and the route check logic which are input to a route setting logic input window 1310 shown in FIG 13 for the relevant geometric patterns. Here, the route setting logic ID is a key for uniquely discriminating the route setting logic module, and identical to the route setting logic ID of the route setting logic index table 400. Incidentally, the reservation target route selection logic includes a logic realizing route determination among the control principles, the train priority determination logic includes a logic realizing train priority management among the control principles, and the route check logic includes a logic realizing collision/derailment prevention among the control principles.

[0045] FIG 2E is a configuration example of the geometric pattern decision table 254 used by the route setting program generation device 100. The geometric pattern decision table 254 has a geometric pattern classification standard and a geometric pattern type as elements. The geometric pattern classification standard has a number of overlap end points, an overlap end point type, a number of end points of route 2 included in route 1, an end point type of route 2 included in route 1, a number of end points of route 1 included in route 2, a type of end points of route 1 included in route 2, and a directional relation between route 1 and route 2 as elements. The geometric pattern classification standard is information used when the geometric pattern extracting portion 212 discriminates the geometric pattern type defined between two routes. The geometric pattern type is a geometric pattern which satisfies each geometric pattern classification standard and is provided with its classification name, and there are 22 patterns (types) in total. And, the geometric pattern classification standard includes those which are physically unrealizable, and they are not given with the geometric pattern type.

[0046] FIG. 3 shows 22 geometric pattern types.

[0047] FIG 3A is an example of "crossing A" registered to No. 1 of the geometric pattern decision table 254. Arrows indicate railways, points, end points and arrows indicated by a solid line indicate the route 1, and points, end points and arrows indicated by a broken line indicate

the route 2. Incidentally, points belonging to both of the route 1 and the route 2 are indicated by a solid line. Directions of the arrows show forward directions of trains in the routes and, for example, a left direction is up, and a right direction is down. The start point 1 and the end point 1 each are the start point and the end point in the route 1, and the start point 2 and the end point 2 each are the start point and the end point in the route 2. The signal 1 and the signal 2 each are signals indicating the entry permission of trains into the route 1 and the route 2. Incidentally, the signals in the drawing have a display surface directed from a circle mark direction toward a vertical bar direction, and give instructions to the train which exists toward the vertical bar direction of the relevant signal. In FIG 3A, the signal 1 and the signal 2 direct the display surface toward the left direction on the drawing. In the "crossing A", the number of overlap end points is 0 end point overlap, and the overlap end point type is none as the geometric pattern classification standard, and this corresponds to the fact that the start point 1, the start point 2, the end point 1 and the end point 2 do not overlap in FIG 3A. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and in FIG 3A, this corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that the directions of both of the route 1 and the route 2 in FIG. 3A are in the right direction. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3A is information irrelevant to determination of the geometric pattern type, but at least two points are required to realize the geometric pattern type of the "crossing A".

[0048] FIG. 3B is an example of "crossing B" registered to No. 2 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "crossing B", it is determined that the number of overlap end points is 0 end point overlap and the overlap end point type is none as the classification standard, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3B. And, it is determined that the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none as the geometric pattern classification standard, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the

route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG 3B. And, the directional relation between the route 1 and the route 2 is a reverse direction as the geometric pattern classification standard, and it corresponds to the fact that the route 1 is in the right direction and the route 2 is in the left direction in FIG 3B. Since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3B is information irrelevant to determination of the geometric pattern type, but at least two points are required to realize the geometric pattern type.

[0049] FIG 3C is an example of "start point blockade A" registered to No. 3 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "start point blockade A", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1 and the end point 2 do not overlap in FIG 3C. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 2 is included in the route 1 in FIG 3C. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is in a forward direction, and it corresponds to the fact that directions of the route 1 and the route 2 are in a right direction in FIG 3C. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3C is information irrelevant to determination of the geometric pattern type, but at least one point is required to realize the geometric pattern type.

[0050] FIG 3D is an example of "start point blockade B" registered to No. 4 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "start point blockade B", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1 and the end point 2 do not overlap in FIG. 3D. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 2 is included in the route 1 in FIG 3D. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is in a reverse direction, and it corresponds to the fact that

the route 1 is in a right direction, and the route 2 is in a left direction in FIG. 3D. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3D is information irrelevant to determination of the geometric pattern type, but at least one point is required to realize the geometric pattern type.

[0051] FIG 3E is an example of "end point blockade A" registered to No. 5 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "end point blockade A", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3E. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the end point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the end point 2 is included in the route 1 in FIG 3E. And, No. 5 in the geometric pattern decision table 254 has, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 in a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3E. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3E is information irrelevant to determination of the geometric pattern type, but at least one point is required to realize the relevant geometric pattern type.

[0052] FIG. 3F is an example of "end point blockade B" registered to No. 6 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "end point blockade B", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3F. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the end point, the number of end points of the route 1 included in the route 2 is 0, the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the end point 2 is included in the route 1 in FIG 3F. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is in a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3F. Incidentally, since the number of points is not included in the geometric pattern classification standard, the

number of points shown in FIG 3F is information irrelevant to determination of the geometric pattern type, but at least one point is required to realize the relevant geometric pattern type.

[0053] FIG 3G is an example of "start-end alternate point blockade" registered to No. 7 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "start-end alternate point blockade", as the classification standard, the number of overlap end points is 0 end point overlap and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3G. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 1, and the end point type of the route 1 included in the route 2 is the end point, and it corresponds to the fact that the start point 1 is included in the route 2 and the end point 2 is included in the route 1 in FIG 3G. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3G. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3G is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0054] Further, No. 8 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 7 in the geometric pattern decision table 254 changed to a reverse direction, but its realization is physically impossible. FIG 3H is an example of "deadlock B" registered in No. 10 in the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "deadlock B", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3H. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 1, and the end point type of the route 1 included in the route 2 is the start point, and it corresponds to the fact that the start point 1 is included in the route 2 and the start point 2 is included in the route 1 in FIG 3H. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3H. Inci-

dentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3H is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0055] Further, No. 9 in the geometric pattern decision table 254 has a directional relation between the route 1, and the route 2 of No. 10 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0056] FIG. 3I is an example of "both end point blockage C" registered to No. 12 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "both end point blockage C", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3I. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the end point, the number of end points of the route 1 included in the route 2 is 1, the end point type of the route 1 included in the route 2 is the end point, and it corresponds to the fact that the end point 1 is included in the route 2 and the end point 2 is included in the route 1 in FIG 3I. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG. 3I. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3I is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0057] Further, No. 11 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 12 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0058] FIG 3J is an example of "start-end point blockage A" registered to No. 13 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "start-end point blockage A", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3J. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 2, the end point type of the route 2 included in the route 1 is both, the number of end points of the route 1 included in the route

2 is 2, and the end point type of the route 1 included in the route 2 is both, and it corresponds to the fact that the start point 1 and the end point 1 are included in the route 2, and the start point 2 and the end point 2 are included in the route 1 in FIG 3J. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3J. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3J is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0059] FIG 3K is an example of "start-end point blockage B" registered to No. 14 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "start-end point blockage B", as the classification standard, the number of overlap end points is 0 end point overlap, and the overlap end point type is none, and it corresponds to the fact that the start point 1, the start point 2, the end point 1, and the end point 2 do not overlap in FIG 3K. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 2, the end point type of the route 2 included in the route 1 is both, the number of end points of the route 1 included in the route 2 is 2, and the end point type of the route 1 included in the route 2 is both, and it corresponds to the fact that the start point 1 and the end point 1 are included in the route 2, and the start point 2 and the end points 2 are included in the route 1 in FIG 3K. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is in a reverse direction, and it corresponds to the fact that the route 1 is a right direction, and the route 2 is in a left direction in FIG. 3K. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3K is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0060] FIG 3L is an example of "forward direction connection" registered to No. 15 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3(A). In the "forward direction connection", as the classification standard, the number of overlap end points is 1 end point overlap, and the overlap end point type is the start point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the start point 2 overlap in FIG 3L. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included

in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG 3L. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3L. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3L is information irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0061] FIG 3M is an example of "reverse direction connection A" registered to No. 16 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "reverse direction connection A", as the classification standard, the number of overlap end points is 1 end point overlap, and the overlap end point types are the start point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the start point 2 overlap in FIG 3M. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG 3M. Here, the overlap of the end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3M. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3M is information irrelevant to determination of the geometric pattern type, but at least one point is required to realize the relevant geometric pattern type.

[0062] FIG. 3N is an example of "reverse direction connection B" registered to No. 18 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "reverse direction connection B", as the classification standard, the number of overlap end points is 1 end point overlap, and the overlap end point types are the start point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the start point 2 overlap in FIG 3N. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1,

the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 is included in the route 2 in FIG 3N. Here, the overlap of the end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3N. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3N is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0063] Further, No. 17 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 18 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0064] FIG. 3O is an example of "reverse direction connection C" registered to No. 20 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "reverse direction connection C", as the classification standard, the number of overlap end points is 1 end point overlap, the overlap end point types are the start point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the start point 2 overlap in FIG 3O. And, as the geometric pattern classification standard, the number of the end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the end point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in route 2 is none, and it corresponds to the fact that the end point 2 is included in the route 1 in FIG 3O. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3O. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3O is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0065] Further, No. 19 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 20 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0066] FIG 3P is an example of "route selection A" registered to No. 21 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines

and signals indicate the same means as those of FIG 3A. In the "route selection A", as the classification standard, the number of overlap end points is 1 end point overlap, and the overlap end point type is the start point of the route 1 and the start point of the route 2, and it corresponds to the fact that the start point 1 and the start point 2 overlap in FIG 3P. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG 3P. Here, the overlap of the end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3P. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3P is irrelevant to determination of the geometric pattern type, but at least one point is required to realize the relevant geometric pattern type.

[0067] FIG 3Q is an example of "route selection B" registered to No. 22 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "route selection B", as the classification standard, the number of overlap end points is 1 end point overlap, the overlap end point types are the start point of the route 1 and the start point of the route 2, and it corresponds to the fact that the start point 1 and the start point 2 overlap in FIG 3Q. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are included in the route 1 in FIG. 3Q. Here, the overlap of the end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3Q. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3Q is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0068] FIG 3R is an example of "route selection C" reg-

istered to No. 23 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "route selection C", as the classification standard, the number of overlap end points is 1 end point overlap, and the overlap end point types are the start point of the route 1 and the start point of the route 2, and it corresponds to the fact that the start point 1 and the start point 2 overlap in FIG 3R. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the end point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the end point 2 is included in the route 1 in FIG 3R. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both the route 1 and the route 2 are in a right direction in FIG 3R. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG 3R is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0069] Further, No. 24 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 23 in the geometric pattern decision table 254 changed to a reverse direction, but its realization is physically impossible.

[0070] FIG 3S is an example of "both end point blockage A" registered to No. 25 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "both end point blockage A", as the classification standard, the number of overlap end points is 1 end point overlap, the overlap end point types are the end point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the end point 2 overlap in FIG 3S. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG. 3S. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both of the route 1 and the route 2 are in a right direction in FIG 3S. Incidentally, since the number of points is not included in the geometric pattern classification

standard, the number of points shown in FIG 3S is irrelevant to determination of the geometric pattern type, but at least one point is required to realize the relevant geometric pattern type.

[0071] FIG 3T is an example of "both end point blockage B" registered to No. 26 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG 3A. In the "both end point blockage B", as the classification standard, the number of overlap end points is one end point overlap, and the overlap end point type is the end point of the route 1 and the end point of the route 2, and it corresponds to the fact that the end point 1 and the end point 2 overlap in FIG 3T. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2, and the start point 2 and the end point 2 are not included in the route 1 in FIG 3T. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3T. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3T is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0072] FIG 3U is an example of "start-end point blockage C" registered to No. 27 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "start-end point blockage C", as the classification standard, the number of overlap end points is 1 end point overlap, the overlap end point types are the end point of the route 1 and the end point of the route 2, and it corresponds to the fact the end point 1 and the end point 2 overlap in FIG 3U. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 1, the end point type of the route 2 included in the route 1 is the start point, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 2 is included in the route 1 in FIG 3U. Here, the overlap of end points is not included in the inclusion. And, as the geometric pattern classification standard, a directional relation between the route 1 and the route 2 is a forward direction, and it corresponds to the fact that directions of both the route 1 and the route 2 are in a right direction in FIG 3U. Incidentally, since the number of points is not included in the geometric pattern classifica-

tion standard, the number of points shown in FIG 3U is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0073] Further, No. 28 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 27 in the geometric pattern decision table 254 changed to a reverse direction, but its realization is physically impossible.

[0074] FIG 3V is an example of "deadlock A" registered to No. 30 of the geometric pattern decision table 254. Notations such as arrows, solid lines, dotted lines and signals indicate the same means as those of FIG. 3A. In the "deadlock A", as the classification standard, the number of overlap end points is 2 end point overlaps, the overlap end point types are the start point of the route 1 and the end point of the route 2 and also the end point of the route 1 and the start point of the route 2, and it corresponds to the fact that the start point 1 and the end point 2 overlap and the end point 1 and the start point 2 overlap in FIG 3V. And, as the geometric pattern classification standard, the number of end points of the route 2 included in the route 1 is 0, the end point type of the route 2 included in the route 1 is none, the number of end points of the route 1 included in the route 2 is 0, and the end point type of the route 1 included in the route 2 is none, and it corresponds to the fact that the start point 1 and the end point 1 are not included in the route 2 and the start point 2, and the end point 2 is not included in the route 1 in FIG 3V. Here, the overlap of the end points is not included in the inclusion. And, as the geometric pattern classification standard, the directional relation between the route 1 and the route 2 is a reverse direction, and it corresponds to the fact that the route 1 is in a right direction, and the route 2 is in a left direction in FIG 3V. Incidentally, since the number of points is not included in the geometric pattern classification standard, the number of points shown in FIG. 3 V is irrelevant to determination of the geometric pattern type, but the relevant geometric pattern type can be realized even when there is not a point.

[0075] Further, No. 29 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 30 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0076] No. 31 in the geometric pattern decision table 254 shows that the route 1 and the route 2 are identical to each other, and a geometric pattern type is not provided particularly.

[0077] No. 32 in the geometric pattern decision table 254 has a directional relation between the route 1 and the route 2 of No. 31 in the geometric pattern decision table 254 changed to a forward direction, but its realization is physically impossible.

[0078] FIG 4A is a configuration example of the geometric pattern-route setting logic type correspondence table 300 used for the route setting program generation

device 100. The geometric pattern-route setting logic type correspondence table 300 has a geometric pattern type and a route setting logic type as elements. The route setting logic type has reservation target route selection, train priority determination, and route check as elements. The geometric pattern type stores 22 geometric pattern types in the geometric pattern decision table 254. The reservation target route selection, the train priority determination, and the route check store information showing whether or not the reservation target route selection, the train priority determination, and the route check each are required as the route setting logic for the relevant geometric patterns. In FIG 4A, it is shown that mark ○ is necessary, and mark × is unnecessary.

[0079] Here, the geometric pattern requiring the reservation target route selection logic includes one with the start points of two routes overlapped and another with the end point of one route overlapped with the start point of the other route, the former is a geometric pattern which is classified to any of the geometric pattern types of (12) Forward direction connection, (13) Reverse direction connection A, (14) Reverse direction connection B, and (15) Reverse direction connection C, and the latter is a geometric pattern which is classified to any of the geometric pattern types of (16) Route selection A, (17) Route selection B, and (18) Route selection C.

[0080] The geometric pattern requiring the train priority determination logic has the start point of one route not overlapped with or included in the other route, and there are geometric patterns which are classified to any of geometric pattern types of (1) Crossing A, (2) Crossing B, (5) End point blockade A, (6) End point blockade B, (9) both end point blockage C, (19) Both end point blockage A, and (20) Both end point blockage B.

[0081] The geometric pattern requiring the route check logic includes one with the start point of one route not overlapped with or included in another route or another requiring at least one point to realize the geometric pattern, and there are geometric patterns which are classified to any of geometric pattern types of (3) Start point blockade A, (4) Start point blockade B, (13) Reverse direction connection A, and (16) Route selection A other than the geometric pattern requiring the train priority determination logic.

[0082] FIG 4B is a configuration example of the route setting logic index table 400 used by the route setting program generation device 100. The route setting logic index table 400 has a route setting logic type, a route setting logic name, and a route setting logic ID as elements. The route setting logic type is composed of reservation target route selection, train priority determination, and route check. The route setting logic name stores logics for realizing the reservation target route selection, the train priority determination, and the route check which are given with identification names. The route setting logic ID is a key for uniquely identifying the route setting logic module and for selecting a route setting logic module stored in the route setting logic library 256. The route

setting logic module stored in the route setting logic library 256 can uniquely identify by giving the route setting logic ID.

[0083] FIG 5 shows a flow of the whole processing performed by the route setting program generation device 100. Processing 500 is started with the activation of the route setting program generation device 100 determined as a trigger, and processing 600, 900, 1200 and 1490 are performed. The processing 600 is processing which is performed by the track layout input portion 211 and receives input of a track layout and a route. When information on the track layout and the route is received from the user, the route setting program generation device 100 shows the screen shown in, for example, FIG 7 as a user interface.

[0084] A detail flow of the processing 600 is shown in FIG 6. The processing 600 is started with the activation of the route setting program generation device 100 as a trigger, and processing 610, 611, 612, 613, 614, 620 and 621 are performed. The processing 600 is processing performed by the track layout input portion 211.

[0085] The processing 610 is processing to repeat the processing 611, 612, 613 and 614, and a termination condition is reception of depression of a button 705 for advancing to the geometric pattern analysis step shown in FIG 7.

[0086] The processing 611 is a processing to accept the input by the user to a station selection window 710 shown in FIG 7, and to obtain information on the station to be input. In FIG 7, the station is, for example, Mikawa Station 712 or Gintenchō Station 713. The station which is subject to input is displayed by, for example, a reversed display or a broken line display of the station, and Gintenchō Station 713 is subject to input in FIG 7. The user, if the station subject to input does not exist in the station selection window 710, can add the station subject to input by depressing a station addition button 704. And, the previous station of the present input object station can be switched by depressing a previous station button 741, and an input object station can be switched to the next station of the present input object station by depressing a next station button 742.

[0087] The processing 612 is processing to accept the input by the user to the track layout input window 730 shown in FIG 7 and to obtain information on the track layout. In FIG 7, the track layout is a line indicated by the thick solid line, for example, the line segments 737, 738, and 739. The user can input the track layout to the track layout input window 730 with, for example, a track layout drawing button 721 in a drawing control window 720 in a depressed state. And, the user can erase the track layout input to the track layout input window 730 with, for example, the track layout drawing button 722 in the drawing control window 720 in a depressed state. Here, the track layout drawing button 721 and the track layout drawing button 722 shall not be depressed simultaneously. The obtained track layout information is stored in the track shape information table 251.

[0088] The processing 613 is processing to accept the input by the user to the track layout input window 730 shown in FIG 7 and to obtain route shape information. In FIG 7, the route is a railway area which is held between two black rhombi, and, for example, the route 733. The route 733 includes therein the line segments 737, 738, 739 as railway area. And, the start point of the route 733 is a black rhombus 735, and the end point is a black rhombus 736. The route direction is indicated by, for example, a route direction arrow 731, and facing right in this example. The user can input a route to the track layout input window 730 with, for example, a route definition button 723 in the drawing control window 720 in a depressed state. As an input method, for example, the start point is decided by selecting a position on the track layout, and then the end point is decided by selecting another position on the track layout. And, the user can erase the route input to the track layout input window 730 with, for example, a route erase button 724 in the drawing control window 720 in a depressed state. Here, the route definition button 723 and the route erase button 724 shall not be depressed simultaneously. And, since the route indicates a railway area from the first inward track circuit to the final inward track circuit provided in the section inward of the signal, the user inputs a route so as to match with the above section. The obtained route information is stored in the route shape information table 252.

[0089] The processing 614 is processing to accept the input by the user to the track layout input window 730 shown in FIG 7 and to obtain neighboring station border information. In FIG 7, the neighboring station border is shown by a thick arrow, and it is, for example, the neighboring station border 731. The user can input, for example, a neighboring station border to the track layout input window 730 with the neighboring station border button 721 in the drawing control window 720 in a depressed state. The neighboring station border can be input to the end point of the line segment only. In this example, the track layout input window 730 is shown in a station unit, but many stations may be shown at one time. In this case, input of the neighboring station border can be omitted. The obtained neighboring station border information is stored in the route shape information table 252.

[0090] Further, the user can write the input track layout information, the route information, and the neighboring station border information into a file by depressing a store button 703. And, when a file read button 701 is depressed, the track layout information, the route information, and the neighboring station border information stored in the file can be read out. And, when an additional file read-in button 702 is depressed, the track layout information, the route information, and the neighboring station border information stored in the file can be additionally read into an existing input content. At this time, if data conflict occurs, it can be solved by, for example, showing a confirmation dialogue about each of the conflict data and accepting the selection by the user.

[0091] The processing 620 is processing to check the

consistency of the track layout information, the route shape information, and the neighboring station border information obtained by the processing 611-614, and it is performed with depression of the button 705 for advancing to the geometric pattern analysis step as a trigger. The consistency check is a check if all line segments, which are stored in, for example, the track shape information table 251, belong to any route stored in the route shape information table 252, and can be realized by searching if all railway element IDs in the track shape information table 251 exist as the values of the corresponding railway element IDs in the route shape information table 252. An error of the signal arrangement can be detected by the processing 620.

[0092] The processing 621 is processing to judge the check result of the processing 620, and if the consistency check by the processing 620 fails, for example, an error message display window 801 of FIG. 8 is shown to notify the failure of the consistency check to the user. Here, if an error content correction button 802 is depressed, the processing 610 is started again, and if an error content disregard button 803 is depressed, the processing 600 is terminated, and the processing 900 is started.

[0093] Back to FIG 5, the processing 900 is processing to decide a geometric pattern type according to the start point and the end point of the signal and also the direction for all arbitrary combinations of two routes among the plurality of routes input by the processing 600, and it is executed by the geometric pattern extracting portion 212. At the time of performing this processing, the route setting program generation device 100 shows, for example, the screen shown in FIG 10 as a user interface.

[0094] A detail flow of the processing 900 is shown in FIG 9. The processing 900 is started with the termination of the processing 600 as a trigger, and processing 910, 920, 921, 922, 923, 924, 925, 930, and 931 are performed. The processing 900 is performed by the geometric pattern extracting portion 212.

[0095] The processing 910 is processing to repeat the processing 920, and the termination condition is completion of repetition on all routes registered in the route shape information table 252. If there are unprocessed routes, one of them is selected.

[0096] The processing 920 is processing to repeat the processing 921, 922, 923, 924, and 925, and the termination condition is completion of repetition on all routes excluding the routes already selected by the processing 910 of the route shape information table 252. If there are unprocessed routes, one of them (but, routes other than those selected by the processing 910) is selected.

[0097] The processing 921 is processing to check the overlap of the start and end points of the route selected by the processing 910 and of the route selected by the processing 920. The overlap check of the start and end points can be realized by comparing, for example, the start point coordinates and the end point coordinates between the two routes in the route shape information table 252.

[0098] The processing 922 is processing to check the inclusion of the start and end points of the route selected by the processing 910 and the route selected by the processing 920. The inclusion check of the start and end points can be realized by, for example, judging the internal point of one route according to the corresponding railway element ID in the route shape information table 252, and judging if the start point coordinates and the end point coordinates of the other route are included in the aforesaid internal point.

[0099] The processing 923 is processing to check the directions of the route selected by the processing 910 and the route selected by the processing 920. The direction check can be realized by, for example, comparing the direction in the route shape information table 252 between the two routes, and if they are same, it is determined as a forward direction, and if different, it is determined as a reverse direction.

[0100] The processing 924 is processing to decide the geometric pattern type by checking the check results of the processing 921, 922, and 923 with the geometric pattern decision table 254. The check against the geometric pattern decision table 254 can be realized by checking, for example, the results of the processing 921 against the number of overlap end points and the overlap end point types in the geometric pattern decision table 254, checking the results of the processing 922 against the number of end points of the route 2 included in the route 1 in the geometric pattern decision table 254, the end point type of the route 2 included in the route 1, the number of end points of the route 1 included in the route 2, and the end point type of the route 1 included in the route 2, and checking the results of the processing 923 against the directional relations of the route 1 and the route 2 in the geometric pattern decision table 254 to obtain the geometric pattern types of the lines with everything coincided.

[0101] The processing 925 is processing to store the geometric pattern type decided by the processing 924 in the geometric pattern storage table 253. For example, when the results of the processing 924 is (16) Route selection A for two routes having Block_#1 and Block_#2 as the route ID, 16 is stored in the geometric pattern type in the geometric pattern storage table 253, Block_#1 is stored in the route 1 ID, and Block_#2 is stored in the route 2 ID.

[0102] The processing 930 is processing to show information stored in the route shape information table 252 and the geometric pattern storage table 523 in a track shape graph display window 1020 shown in FIG 10. In FIG 10, the route stored in the route shape information table 252 is shown, for example, as route F 1021. And, the geometric pattern type stored in the geometric pattern storage table 523 is shown by a pattern of line or arrow connecting between two routes. For example, the geometric pattern type between route D and route F is shown like a forward direction connection geometric pattern 1022. The geometric pattern type is shown so that the

user can identify from a geometric pattern icon 1011 in, for example, a geometric pattern list window 1010. Further, the geometric pattern to which the track shape graph display window 1020 applies may be highlighted with depression of the geometric pattern icon 1011 by the user.

[0103] Processing 940 is processing to check the consistency about the result of the processing 910. The consistency check is, for example, a check whether the geometric pattern types for entry of the train to routes are defined for all routes. It can be realized by searching all routes registered in the route shape information table 252 to find that the route 1 ID or the route 2 ID of the geometric pattern storage table 7523 is the relevant route and that there is at least one of 12, 13, 14, and 15 stored as values of the geometric pattern types. Adequacy of signal arrangement can be verified by the processing 930.

[0104] Processing 941 is processing to judge the check result of the processing 940. If the consistency check by the processing 930 fails, for example, an error message display window 1101 and an error range 1142 of FIG 11 are shown to notify the failure of the consistency check to the user. Here, if an error content correction button 1103 is depressed, the processing 600 is started again, and if an error content disregard button 1104 is depressed, the processing 940 is performed.

[0105] Processing 950 is processing to wait that a button 1001 for forwarding to a route setting logic selection step is depressed by the user, and the processing 900 is terminated with the depression of the button 1001 for forwarding to the route setting logic selection step as a trigger, and the processing 1200 is started.

[0106] Back to FIG 5, the processing 1200 is processing to associate the route setting logic with the geometric pattern between two routes which had the geometric pattern type defined by the processing 900, and provides, for example, the screen shown in FIG 13 as a user interface. A detail flow of the processing 1200 is shown in FIG 12. The processing 1200 is started with the termination of the processing 900 as a trigger, and processing 1210, 1211, 1212, 1213, 1214 and 1220 are performed. The processing 1200 is processing performed by the route setting logic selection portion 213.

[0107] The processing 1210 is processing to repeat the processing 1211, 1212, 1213 and 1214, and a termination condition is reception of depression of a button 1301 for advancing to the program operation check step.

[0108] The processing 1211 is processing to obtain geometric patterns (namely, a combination of two routes) which are subject to route setting logic selection from the track shape graph display window 1020. The user can designate geometric patterns which are subject to the route setting logic selection by selecting arbitrary geometric patterns from the track shape graph display window 1020 shown in FIG. 13. Now, in FIG 13, the geometric patterns which are subject to the route setting logic selection are a geometric pattern defined between route J and route K. Here, the geometric pattern which is subject to the route setting logic selection may be highlighted

so that the user can easily identify the geometric pattern which is subject to the route setting logic selection.

[0109] The processing 1212 is processing to show the route setting logic input window 1310 on the screen. Here, display items in the route setting logic input window 1310 are determined by comparing the geometric pattern type of the geometric pattern which is subject to the route setting logic selection with the geometric pattern-route setting logic type correspondence table 300 (see FIG. 4A). In the example of FIG 13, the geometric pattern type of the geometric pattern which is subject to the route setting logic selection is (19) Both end point blockage A, and a route setting logic type of a line where the geometric pattern type of the geometric pattern-route setting logic type correspondence table 300 corresponding to (19) Both end point blockage A has mark × in the reservation target reservation object route selection, mark ○ in the train priority determination, and mark × in the route check. Therefore, train priority determination and route check are shown in the route setting logic input window 1310.

[0110] The processing 1213 is processing to obtain the designation of a route setting logic from the route setting logic input window 1310. The user can select and set the route setting logic from a pull-down menu 1311 of the route setting logic input window 1310. The processing 1213 obtains the designation of the route setting logic which is set in the pull-down menu. Here, the route setting logic shown in the pull-down menu 1311 is registered in the route setting logic index table 400 (see FIG 4B). And, to prevent the user from selecting an incorrect route setting logic, the route setting logics, whose route setting logic type is different from the route setting logic type corresponding to the pull-down menu 1311, among the route setting logics registered in the route setting logic index table 400, may be hidden. And, if a route setting logic which was already selected for another geometric pattern has a possibility of performing an erroneous operation by interfering with a route setting logic selected for a geometric pattern which is subject to the route setting logic selection, the relevant route setting logic in the pull-down menu 1311 may be hidden. And, when detection of interference of the route setting logic is performed by the processing 1220, and if the interference is detected, the error display window may be popped up on the screen. Here, the case where the route setting logic already selected with another geometric pattern operates erroneously by interfering with the route setting logic selected with the geometric pattern which is subject to the route setting logic selection is, for example, a case where when a geometric pattern T1 between the route A and the route B and a geometric pattern T2 between the route A and the route C need train priority determination, T1, has timetable time sequence of the route setting logic index table 400 set as a route setting logic for train priority determination, but T2 has train position sequence of the route setting logic index table 400 set as a route setting logic for train priority determination. Details of the time-

table time sequence and the train time sequence in the route setting logic index table 400 are described later. And, the user can import a route setting logic not registered in the route setting logic index table 400 from an external file by depressing an import button 1312. The file to be imported is, for example, a source code file describing the processing contents of a route setting logic or an executable module file which has compiled the source code file. And, a parameter of the route setting logic selected by depressing an attribute setting button 1313 can be set. Further, the geometric pattern with selection of the route setting logic completed may be made to be identifiable easily by the user by giving, for example, an icon. And, an enlarge/reduce button may be added to the track shape graph display window 920, so that the screen can be enlarged or reduced.

[0111] The processing 1214 is processing to store the route setting logic information selected or imported by 1213 into the selected route setting logic storage table 255. The processing 1214 is started with reception of the depression of an input decision button 1314 in the route setting logic input window 1310 as a trigger, the route setting logic input from the pull-down menu 1311 in the route setting logic input window 1310 is obtained, and the corresponding route setting logic ID is stored in the selected route setting logic storage table 255. If a cancel button 1315 is depressed after the processing 1213, nothing is performed by the processing 1214, and the procedure moves to the processing 1211.

[0112] The processing 1220 is processing to wait that the button 1301 for advancing to the program operation check step is depressed by the user, and the processing 1200 is terminated with reception of the depression of the button 1301 for advancing to the program operation check step as a trigger, and the processing 1490 is started.

[0113] Back to FIG. 5, the processing 1490 is processing to generate the route setting program 1400, which is a program for realizing the route setting device 9900, from the route shape information table 252 generated by the processing 600, the geometric pattern storage table generated by the processing 900, the selected route setting logic storage table 255 generated by the processing 1200, and the route setting logic library 256 and the railway traffic management core module 257 previously held within the route setting program generation device 100, and shows an operation check screen.

[0114] A detail flow of the processing 1490 is shown in FIG 14H. The processing 1490 is started with the termination of the processing 1200 as a trigger, and processing 1491, 1492, 1493, 1494 and 1495 are performed. The processing 1490 is processing performed by a program module connection portion.

[0115] The processing 1491 is processing to generate a geometric information table 1482 shown in FIG 14C from the geometric pattern storage table 253 (see FIG 2C) and the selected route setting logic storage table 255 (see FIG 2D). Generation of the geometric information

table 1482 can be realized by retrieving and coupling lines having the same geometric pattern ID by, for example, both of the geometric pattern storage table 253 and the selected route setting logic storage table 255.

5 **[0116]** The processing 1492 is processing to generate a route information table 1483 shown in FIG 14D from the geometric pattern storage table 253 (see FIG 2C) and the route shape information table 252 (see FIG 2B).
10 As to the geometric pattern ID column in the route information table 1483, each of the route ID in the route shape information table 252 can be identified by retrieving a matching one from the route 1 ID and the route 2 ID in the geometric pattern storage table 253 and extracting a corresponding geometric pattern ID. The station column and the related facilities column in the route information table 1483 are key information for associating the state of the trackside facilities 9940, which is obtained from the facility state 1487 of the trackside facilities information management portion 1452, with the routes, and generated by reading, for example, a previously defined one as a file. Otherwise, for example, when the user selects the route F 1021 in the track shape graph display window of FIG. 10, the designation of the trackside facilities to be associated with the route may be accepted from the user by a method of showing a facility input screen or the like and determined as input of the station column and the related facilities column.

20 **[0117]** The processing 1493 is processing to generate a route setting logic module group 1486 by selecting a route setting logic appearing in the selected route setting logic storage table 255 (see FIG 2D) from the route setting logic library 256. The generation of the route setting logic module group 1486 is realized by, for example, managing each route setting logic in the route setting logic library 256 as an object file, extracting the object file corresponding to the route setting logic appearing in the selected route setting logic storage table 255 and storing in the route setting logic module group 1486.

30 **[0118]** The processing 1494 is processing to generate the route setting program 1400 from the railway traffic management core module library 257, the geometric information table 1482 (FIG. 14C), the route information table 1483 (FIG 14D), and the route setting logic module group 1486. That is, the processing 1494 generates the route setting program 1400 by combining the geometric information table 1482 generated by the processing 1491, the route information table 1483 generated by the processing 1492 and the route setting logic module group 1486 generated by the processing 1493 with the route reservation management portion 1410, a plan type system information management portion 1451, the trackside facilities information management portion 1452, the communication management portion 1460, the input interface 1471, the output interface 1472, the reservation processing intermediate data storage table 1481, the route state table 1484, the route entering train table 1485, the timetable 1487, the facility state 1488 which is a module previously stored within the railway traffic manage-

ment core module library 256.

[0119] A software configuration example of the route setting program 1400 generated by the processing 1494 is shown in FIG. 14A. The route setting program 1400 is composed of the route reservation management portion 1410, the plan type system information management portion 1451, the trackside facilities information management portion 1452, the communication management portion 1460, the input interface 1471, and the output interface 1472.

[0120] The route reservation management portion 1410 is a portion which receives the timetable 1487 and the facility state 1488 from the plan type system information management portion 1451 and the trackside facilities information management portion 1452 respectively, computing a control state of a signal by the route reservation processing, and outputs a signal control request to the trackside facilities information management portion 1452. When the route is reserved by the route reservation management portion 1410, the route setting device 9900 makes a proceed indication control request of a signal to the ground device 9920 with the relevant route determined as a protection section based on the signal control request output by the route reservation management portion.

[0121] The plan type system information management portion 1451 is a portion which receives, for example, plan information such as a timetable from the plan type system 9910 and provides information in response to the request of the route reservation management portion 1410.

[0122] The trackside facilities information management portion 1452 is a portion which receives, for example, trackside facilities information such as facility state from the ground device 9920, and provides information in response to the request by the route reservation management portion 1410. And, it is a portion which receives a signal control request from the route reservation management portion 1410, and outputs a signal control request to the ground device 9920.

[0123] The communication management portion 1460 is a portion for managing communications with, for example, external devices such as the plan type system 9910, the ground device 9920, etc. The input interface 1471 and the output interface 1472 are portions for performing communications with, for example, external devices such as the plan type system 9910, the ground device 9920, etc.

[0124] FIG 14B shows one example of the reservation processing intermediate data storage table 1481 used by the route setting program 1400. The reservation processing intermediate data storage table 1481 has a reservation request route, a reservation target route, and a previous reservation target route as elements, and stores the values (identification information) of the reservation request route, the reservation target route, and the previous reservation target route which are under processing. The values stored in the reservation process-

ing intermediate data storage table 1481 are, when the route setting program 1400 is executed, updated during its processing. Details are described later.

[0125] FIG. 14C shows one example of the geometric information table 1482 used by the route setting program 1400. The geometric information table 1482 has a geometric pattern ID, a geometric pattern type, a route 1 ID, a route 2 ID, a reservation target route selection logic, a train priority determination logic, a route check logic (route 1→route 2), and a route check logic (route 2→route 1) as elements. The geometric pattern ID, the geometric pattern type, the route 1 ID, and the route 2 ID are identical to those of the geometric pattern storage table 253, and the reservation target route selection logic, the train priority determination logic, the route check logic (route 1→route 2), and the route check logic (route 2→route 1) are identical to those of the selected route setting logic storage table.

[0126] FIG 14D shows one example of a route information table 1483 used by the route setting program 1400. The route information table 1483 has a route ID, a geometric pattern, a station, and related facilities as elements. The geometric pattern stores geometric pattern IDs of all geometric patterns defined between the routes identified by the route ID and other routes. The station stores stations to which the routes identified by the route IDs belong. The related facilities store all facilities required for decision of the facility state in the route of the route identified by the route ID. Here, all facilities required for decision of a route-inside facility state of the relevant route are, for example, a track circuit which is within a railway area indicated by the relevant route, a signal which determines the relevant route as a protection section, a point and a crossing which are within the railway area indicated by the relevant route, and a railway track closing lever which is a lever for performing a stop indication instruction to a signal which determines the relevant route as a protection section. When a certain route is reserved (when a reservation state of the route state table 1484 described later becomes "under reservation"), the proceed indication control request is output by the route setting program 1400 to the signal register as related facilities corresponding to the relevant route in the route information table 1483.

[0127] FIG 14E shows one example of the route state table 1484 used by the route setting program 1400. The route state table 1484 has a route ID, a reservation state, a reserved train, an on-rail train, an on-rail train position, and a route-inside facility state as elements. The reservation state stores "under reservation" if the route designated by the route ID is reserved by the train and stores non-reserved if not. The reserved train stores an identifier of the train which has reserved the relevant route when the relevant route is in a reserved state. The on-rail train stores the identifier of the relevant train if the train exists on the relevant route. If the train is on the relevant route, the on-rail train position stores the position of the train which is within the route. The on-rail train and the on-rail

position are updated based on information collected as needed from the trackside facilities 9940 by the trackside facilities information management portion 1488. The route-inside facility state stores whether all facilities related to the relevant route can be controlled and takes, for example, two values of available and unavailable. Decision whether all facilities related to the relevant route are available is performed by, for example, checking whether all facilities meet the available condition with reference to the state of all facilities of related facilities column corresponding to the relevant route in the route information table 1483.

[0128] FIG 14F shows one example of the route entering train table 1485 used by the route setting program 1400. The route entering train table 1485 has a route ID, an entry scheduled train, and non-entered/entered as elements. The entry scheduled train stores the identifiers of trains scheduled to enter the route designated by the route ID and arranged in entering time sequence on the train operation plan, which are created by retrieving the route ID of the relevant route from the routes on the train path of, for example, the timetable 1487 and arranging corresponding train IDs in passing-entrance time sequence. The non-entered/entered stores whether the aforesaid train has entered the route, and, for example, if not entered, it stores non-entered, and if entered already, it stores entered. The non-entered/entered information is also updated based on information collected as needed from the trackside facilities 9940 by the trackside facilities information management portion 1488.

[0129] FIG 14G shows one example of the timetable 1487 used by the route setting program 1400. The timetable 1487 has a train ID, a routes on the train path, and a entrance time as elements. The train ID is a key for uniquely identifying a train, for example, a train number. The routes on the train path stores all routes through which the relevant train is scheduled to pass on the train operation plan. The routes on the train path is obtained from, for example, the plan type system 9910 by communicating through the input interface 1471 and the communication management portion 1460. If the train operation plan obtained from the plan type system 9910 is not created in the route unit, for example, a conversion rule definition table is created in the plan type system information management portion 1451, and the train operation plan is converted to a plan of a route unit. The case that the train operation plan is not created in a route unit is, for example, a case that the start and end times of the train are given to each track No. of the station. The entrance time stores times when the relevant train passes through the aforesaid route. The timetable 1487 is obtained from the plan type system 9910 through the input interface 1471 and the communication management portion 1460.

[0130] Back to FIG 14H, the processing 1495 is processing to execute the route setting program 1400 created by the processing 1494 and to provide the executed result to the user and, for example, the screen

shown in FIG 19 is shown as a user interface.

[0131] The route setting program 1400 is initialized when the depression of an initializing button 2102 is accepted. The time in the program is shown in a program execution control window 2110, and the user can operate a program-inside time 2111 through the input device such as a keyboard to reproduce the state of the designated program-inside time by the route setting program 1400. And, the user can instruct fast-forward, rewinding, pause, or pause cancellation of the route setting program 1400 through a time controller 2112.

[0132] The internal state of the route setting program 1400 is shown in a track shape graph display window 2130. What is shown in the track shape graph display window 2130 is information that has the contents of the route state table 1484 reflected in the track shape information shown in the track shape graph window 1020. The route under reservation can be identified by making a double line display (may also be reverse displayed) like, for example, a route B 2132. A non-reserved route can be identified by a dotted line display like, for example, a route L 2133. A route about which reservation attempted by a train fails may be identified by a solid line display like, for example, a route D 2134. And, at this time, the reservation attempted train may be identified by, for example, a reservation attempted train icon 2135, and a route setting logic causing a failure may be identified by a reservation failure cause route setting logic icon 2136. In FIG 19, the reservation attempted train icon 2135 shows that train T attempted to reserve the route D 2134 but failed. And, the reservation failure cause route setting logic icon 2136 shows that the reservation was failed because the route check logic execution result was a failure.

[0133] The user can select, for example, a route or a geometric pattern from the track shape graph display window 2130, and the route setting program 1400 accepting the selection can show detailed information on the relevant route or geometric pattern in an information display window 2120. What is shown in the information display window 2120 is information registered in the route state table 1484, the route information table 1483, the route entering train table 1485, and the geometric information table 1482. For example, in FIG. 19, a route E 2137 is in a selected state, and the information display window 2120 shows the name of the route E 2137, an on-rail train, a train position, and owned facility information. The user can know the internal state of the route setting program 1400 by checking the track shape graph display window 2130. And, by operating the program time through the program execution control window 2110 at the same time, it can be confirmed whether the program is operating normally in respective time slots. If the program does not operate to meet the intention of the user, the cause can be investigated by checking the information display window 2120. Further, the screen shown in FIG 19 may be output by the route setting program 1400 not only when the route setting program 1400 is executed

to check the generated program, but also when the route setting program 1400 is executed by the route setting device 9900 to perform route setting of the train.

[0134] A flow of processing of the route setting program 1400 generated by the processing 1494 is shown in FIG 15 with a focus on processing of the route reservation management portion 1410. The processing flow shown in FIG 15 is equivalent to the processing flow when the route setting program 1400 is executed by the above described processing 1495 or when the route setting program 1400 generated by the processing 1494 is installed in the route setting device 9900 and performed by the route setting device.

[0135] As described above, the route setting program 1400 provides the screen shown in, for example, FIG 19 as a user interface. Processing 1500 is started upon receiving depression of the initializing button 2102 of FIG 19, and processing 1510, 1511, 1520, 1521, 1522, 1523, 1524, 1525, 1526, 1530, 1531, 1532 and 1533 are performed. The processing 1500 may be repeated at each designated cycle such as, for example, a two-second cycle or may be executed with the reception of a state change from the group of trackside facilities 9920 or the plan type system 9910 as a trigger.

[0136] The processing 1510 is processing to clear the previous processed results and to clear the reservation state column and the reserved train column of the route state table 1484 for all routes.

[0137] The processing 1511 is processing to retrieve a route which becomes a starting point of the route reservation processing, and to identify a route where the train is stored in the on-rail train column of the route state table 1484.

[0138] The processing 1520 is processing to execute the reservation of the route and repeated for all routes identified by the processing 1511. Here, for each of repeatedly performed processing 1521 and following, one route selected from the plurality of routes identified as targets to be processed by the processing 1511 is called a reservation request route below.

[0139] The processing 1521 is processing to set (record) the route ID of the reservation request route to the reservation request route column and the previous reservation target route column of the reservation processing intermediate data storage table 1481.

[0140] The processing 1522 is processing to retrieve the route ID registered as the previous reservation target route in the reservation processing intermediate data storage table 1481 from the route information table 1483 and to obtain all geometric patterns corresponding to the route ID.

[0141] The processing 1523 is processing to determine and execute a corresponding reservation target route selection logic from the geometric information table 1482 for the geometric patterns with ○ stored in the reservation target route selection column of the geometric pattern-route setting logic type correspondence table 300 among the geometric patterns obtained by the

processing 1522, and to set the results in the reservation target route column of the reservation processing intermediate data storage table 1481. Here, details of the reservation target route selection logic are described later.

5 **[0142]** The processing 1524 is processing to retrieve the route ID, which is registered as the reservation target route in the reservation processing intermediate data storage table 1481, from the route information table 1483 to obtain all geometric patterns corresponding to the route ID.

10 **[0143]** The processing 1525 is processing to decide and execute the corresponding train priority determination logic from the geometric information table 1482 for geometric patterns with ○ stored in the train priority determination column of the geometric pattern-route setting logic type correspondence table 300 among the geometric patterns obtained by the processing 1524. Here, details of the train priority determination logic are described later.

20 **[0144]** The processing 1526 is processing to decide and execute the corresponding route check logic from the geometric information table 1482 for the geometric patterns with ○ stored in the route check column of the geometric pattern-route setting logic type correspondence table 300 among the geometric patterns obtained by the processing 1524. Here, details of the route check logic are described later.

25 **[0145]** The processing 1530 is processing to judge whether all execution results of the processing 1525 and 1526 are success. When all are success, the procedure moves to processing 1531, but if any one of them is a failure, the procedure returns to the repeated processing of the processing 1520 to select another route from a plurality of routes identified by the processing 1511, and it is determined as a reservation request route to continue processing.

30 **[0146]** The processing 1531 is processing to retrieve a route ID which is registered as a reservation target route in the reservation processing intermediate data storage table 1481 from the route state table 1484 and to set as reserved in the reservation state column corresponding to the relevant route ID.

35 **[0147]** The processing 1532 retrieves from the route state table 1484 an route ID registered as a reservation target route in the reservation processing intermediate data storage table 1481 and a route ID registered as a reservation request route in the reservation processing intermediate data storage table 1481. And, it is processing to set identification information of an on-rail train corresponding to the route ID registered as the reservation request route into the reserved train column corresponding to the route ID registered as the reservation target route.

40 **[0148]** The processing 1533 is processing to set the route ID, which is registered as a reservation target route in the reservation processing intermediate data storage table 1481, as a previous reservation target route in the reservation processing intermediate data storage table

1481.

[0149] The reservation target route selection logic performed by the processing 1523 of FIG 15 is a logic for deciding a route which is subject to the reservation processing and includes, for example, a priority route selection logic and a timetable route selection logic. By the priority route selection logic, priority is previously given to two routes related to the geometric pattern types of (16) Route selection A, (17) Route selection B, and (18) Route selection C, and when the train selects one of the relevant two routes as a reservation target route, the route with higher priority is selected. At this time, if the route with higher priority cannot be reserved because of reasons such as the presence of another train already on the route, the route with lower priority is selected as the reservation target route. According to the timetable route selection logic, the train route is previously defined according to, for example, a timetable, and when the train is to select one of the relevant two routes as a reservation target route, it selects a route, which is defined as a route on, for example, the timetable, as the train route. A flow of processing of one example of the timetable route selection logic is shown in FIG 16.

[0150] Processing 1600 is an example of the timetable route selection logic which is one example of the reservation target route selection logic, and the route setting program 1400 executes processing 1610, 1620, 1630, 1631, 1632, 1640, 1641, and 1650.

[0151] The processing 1610 is processing to count, among the geometric patterns obtained by the processing 1522 referring to the geometric information table 1482, the number of those which belong to the geometric pattern type of any of (12) Forward direction connection, (13) Reverse direction connection A, (14) Reverse direction connection B and (15) Reverse direction connection C and have the route 1 coinciding with the previous reservation target route of the reservation processing intermediate data storage table 1481.

[0152] The processing 1620 is processing to judge whether or not the number of geometric patterns counted by the processing 1610 is equal to 1. When the number of geometric patterns counted by the processing 1610 is 1, the processing 1650 is performed, and when it is 2 or more, the processing 1630 is performed. And, when it is 0, there is no route where the train can proceed, and the processing 1600 is terminated.

[0153] The processing 1650 is processing performed when the number of geometric patterns counted by the processing 1610 is equal to 1. Here, the fact that the number of geometric patterns counted by the processing 1610 is equal to 1 means that there is only one route to which the train existing on the previous reservation target route can enter next. For the geometric patterns counted by the processing 1610, the processing 1650 sets, as the reservation target route in the reservation processing intermediate data storage table 1481, one which does not coincide with the reservation target route in the reservation processing intermediate data storage table 1481

between the route 1 column and the route 2 column registered in the geometric information table 1482. When the processing 1650 is completed, the processing 1600 is terminated.

[0154] The processing 1630 is processing performed when the number of geometric patterns counted by the processing 1610 is 2 or more. Here, the fact that the number of geometric patterns counted by the processing 1610 is 2 or more means that there are a plurality of routes where the train existing on the previous reservation target route can enter next, and the train must select one from them to enter. The processing 1630 repeats the processing 1631, 1632, and 1640 for all geometric patterns which are subject to counting by the processing 1610.

[0155] The processing 1631 is processing to extract a route into which the train which is on the previous reservation target route can enter next. For the geometric patterns which are subject to this processing, the processing 1631 selects, among them, one which does not coincide with the reservation target route in the reservation processing intermediate data storage table 1481 referring to corresponding route 1 and route 2 columns in the geometric information table 1482.

[0156] The processing 1632 is processing to judge whether the route extracted by the processing 1631 coincides with the route of the train on the timetable. The processing 1632 judges the train, which is stored in the on-rail train column of the reservation request route in the route state table 1484, whether the route selected by 1631 is included in the routes on the train path column of the relevant train in the timetable 1486.

[0157] The processing 1640 is processing to perform branching according to the determination result of the processing 1632. When the determination result of the processing 1632 is "included", the processing 1641 is performed. If "not included", the procedure returns to the processing 1630.

[0158] The processing 1641 is processing to set the route selected by 1632 as a reservation target route in the reservation processing intermediate data storage table 1481. When the processing 1641 is completed, the processing 1600 is terminated.

[0159] The train priority determination logic which is performed by the processing 1525 of FIG. 15 is processing to judge whether a train operation sequence is satisfied when the route is reserved, and there are, for example, a timetable time sequence logic and a train position sequence logic. Here, the train operation sequence is not necessarily required to be given as a train operation plan by the plan type system 9910, but it must be at least assured that a deadlock does not occur by the reservation of the route. For example, the deadlock occurs when the up train and the down train enter a single-track section at the same time. The train priority determination logic is performed when geometric patterns corresponding to the reservation target route are classified to any of (1) Crossing A, (2) Crossing B, (5) End point blockade A, (6) End

point blockade B, (9) Both end point blockage C, (19) Both end point blockage A, and (20) Both end point blockage B which are geometric pattern types with ○ marked in the train priority determination row in the geometric pattern-route setting logic type correspondence table 300 (FIG 4A), and when there are a plurality of geometric patterns belonging to the above geometric pattern types, it is performed on all of them.

[0160] In a case where the timetable time sequence logic is used as the train priority determination logic for the two routes, the route 1 and the route 2, which have any of the relations of the above-described geometric pattern types (1) Crossing A, (2) Crossing B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (19) Both end point blockage A and (20) Both end point blockage B, for example, the order of the trains entering the above two routes is defined according to the timetable, and the train T is not allowed to reserve the route 1 or the route 2 if the train T is not first in order of its entry to the route 1 or the route 2.

[0161] A flow of processing of one example of the timetable time sequence logic is shown in FIG 17.

[0162] Processing 1700 is an example of a timetable time sequence logic which is one example of the train priority determination logic, and the route setting program 1400 executes processing 1710, 1720, 1721, 1722, 1723, 1724, 1730, 1731 and 1732.

[0163] The processing 1710 is processing to extract from the geometric patterns obtained by the processing 1524 all belonging to any of (1) Crossing A, (2) Crossing B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (19) Both end point blockage A and (20) Both end point blockage B, which are geometric pattern types with ○ marked in the train priority determination row in the geometric pattern-route setting logic type correspondence table 300 (FIG 4A).

[0164] The processing 1720 is processing to repeat the processing 1721, 1722, 1723 and 1724 on all geometric patterns extracted by the processing 1710. Here, the processing 1721 to the processing 1724 judge two routes corresponding to the geometric patterns which are subject to the processing whether the train existing on the reservation request route is first in the entry sequence into the relevant route with reference to the entry sequence of the entry scheduled train defined on the timetable. To perform the judgement, the following two equivalently decomposed conditions are considered. Condition 1 is that the train existing on the reservation request route is a train next entering the route, based on a timetable, which matches with the reservation target route between the two routes corresponding to the geometric patterns which are subject to the processing. Condition 2 is that the entered time to the relevant route of the train entering next to the route which is not a reservation target route between the two routes corresponding to the geometric pattern which is subject to the processing is earlier than the entered time to the reservation target route of the train which exists on the reservation request route.

Between them, the condition 1 is a condition which is certainly fulfilled if there is no mismatching of the timetable, so that the condition is not checked explicitly by the processing shown in FIG 17, but the condition check may be performed explicitly aiming at the verification of validity of the timetable.

[0165] The processing 1721 is processing to refer to corresponding route 1 and route 2 columns in the geometric information table 1482 for the geometric patterns which are subject to the processing 1720 and to select one from them, which is inconsistent with the reservation target route in the reservation processing intermediate data storage table 1481.

[0166] The processing 1722 is processing to determine the train, which is earliest in the entry sequence to the route selected by the processing 1721, among those which are non-entry in the non-entry/entered column in the route entering train table 1484.

[0167] The processing 1723 is processing to refer to the timetable 1487 and to obtain the entrance time column of the line in which the train ID column coincides with the train selected by the processing 1722 and the routes on the train path column coincides with the route selected by the processing 1721.

[0168] The processing 1724 is processing to identify a train existing on a reservation request route from the route state table 1484 and to obtain a entrance time corresponding to the reservation target route from the timetable 1486 for the identified train.

[0169] The processing 1730 is processing to judge whether the time obtained by the processing 1724 is earlier than the time obtained by the processing 1723.

[0170] If the time obtained by the processing 1724 is earlier than the time obtained by 1723, the processing 1721 to the processing 1724 are performed for other geometric patterns. If it is determined by the processing 1730 for all geometric patterns identified by the processing 1710 that the time obtained by the processing 1724 is earlier than the time obtained by the processing 1723, the processing 1731 is performed to return a success as an execution result.

[0171] Meanwhile, if it is determined by the processing 1730 that the time obtained by the processing 1724 is earlier than the time obtained by the processing 1723, the processing 1732 is performed, and a failure is returned as a performed result.

[0172] Here, if the time obtained by the processing 1724 is the same as the time obtained by the processing 1723, for example, an error message is output on the display, and the result is determined by a method that the user instructs manually a success or a failure, or the like. Otherwise, priority of two routes is defined in advance, and if the reservation target route has priority higher than that of another route, a success is returned, but if not, a failure may be returned. The route check logic performed by the processing 1526 in FIG 15 is processing to secure that collision or derailment of the train does not occur when the route is reserved, and there are, for ex-

ample, an on-rail train check logic and a train position check logic. The route check logic is performed when the geometric pattern corresponding to the reservation target route is classified to any of (1) Crossing A, (2) Crossing B, (3) Start point blockade A, (4) Start point blockade B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (13) Reverse direction connection A, (16) Route selection A, (19) Both end point blockage A, and (20) Both end point blockage B which are geometric pattern types with 0 marked in the route check row in the geometric pattern-route setting logic type correspondence table 300, and if it is classified to a plurality of geometric pattern types, it is performed on all of them.

[0173] According to the on-rail train check logic, when the train T is to reserve either of the route 1 and the route 2 which are two routes having a relation of geometric pattern type of any of (1) Crossing A, (2) Crossing B, (3) Start point blockade A, (4) Start point blockade B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (13) Reverse direction connection A, (16) Route selection A, (19) Both end point blockage A, and (20) Both end point blockage B, reservation of the route 1 or the route 2 by the train T is not permitted if another train already exists on the other route.

[0174] The train position check logic defines previously a standard position P within the route for the route 1 and the route 2 which are two routes having a relation of the geometric pattern type of any of (1) Crossing A, (2) Crossing B, (3) Start point blockade A, (4) Start point blockade B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (13) Reverse direction connection A, (16) Route selection A, (19) Both end point blockage A, and (20) Both end point blockage B. In a case where the train T is to reserve the route 1 or the route 2, if another train U already exists on the other route and the on-rail position of the train U is positioned in front of the standard position P, reservation of the route 1 or the route 2 by the train T is not permitted.

[0175] A flow of processing of one example of the on-rail train check logic is shown in FIG 18.

[0176] Processing 1800 is an example of a train position check logic which is one example of the route check logic, and the route setting program 1400 executes processing 1810, 1820, 1821, 1822, 1830, 1831 and 1832.

[0177] The processing 1810 is processing to extract, from the geometric patterns obtained by the processing 1524, all which are classified to any of (1) Crossing A, (2) Crossing B, (3) Start point blockade A, (4) Start point blockade B, (5) End point blockade A, (6) End point blockade B, (9) Both end point blockage C, (13) Reverse direction connection A, (16) Route selection A, (19) Both end point blockage A, and (20) Both end point blockage B which are geometric pattern types with ○ marked in the route check row in the geometric pattern-route setting logic type correspondence table 300.

[0178] The processing 1820 is processing to repeat

the processing 1821, 1822, and 1830 on all geometric patterns extracted by the processing 1810.

[0179] The processing 1821 is processing to refer to the corresponding route 1 and route 2 columns in the geometric information table 1482 for the geometric patterns which are subject to the processing, and to select one of them, which is inconsistent with the reservation target route in the reservation processing intermediate data storage table 1481.

[0180] The processing 1822 is processing to judge whether a train already exists on the route selected by the processing 1821. The processing 1822 judges for the route selected by the processing 1821 whether a train is set to the corresponding on-rail train column of the route state table 1484.

[0181] The processing 1830 is processing to judge the result of the processing 1822.

[0182] If the train did not exist on the route selected by the processing 1821, the processing 1830 is performed on another geometric pattern extracted by the processing 1810 from the processing 1821. For all geometric patterns extracted by the processing 1810, if a train did not exist on the route selected by the processing 1821, the processing 1831 is performed, and a success is returned as an execution result.

[0183] Meanwhile, if a train exists on the route which was selected by the processing 1821, the processing 1832 is performed, and a failure is returned as a performed result.

[0184] The embodiments of the invention were described above but it is merely examples. And, the generation of the program for realizing the route setting device of the railway traffic management system is merely one embodiment of the invention. In addition, the present invention can be used extensively for generation of a program for realizing a device that controls an object moving on a track, which is divided into prescribed sections, limits objects simultaneously existing on the relevant section to one at most, and enables to know in which sections the objects exist. In this case, the generation of the program can be realized by the same procedure as the above-described embodiment by replacing the section with a route and the object with a train.

[0185] The above description was made on the embodiment, but the present invention is not limited to it and it is evident to a person skilled in the art that various modifications and variations can be made within the spirit and the scope of the present invention.

50 REFERENCE SIGNS LIST

[0186]

100	Route setting program generation device
211	Track layout input portion
212	Geometric pattern extracting portion
213	Route setting logic selection portion
214	Program module connection portion

220	Controller portion	
230	Screen management portion	
241	Input interface	
242	Output interface	
251	Track shape information table	5
252	Route shape information table	
253	Geometric pattern storage table	
254	Geometric pattern decision table	
255	Selected route setting logic storage table	
256	Route setting logic library	10
257	Railway traffic management core module library	
300	Geometric pattern-route setting logic type correspondence table	
400	Route setting logic index table	
1400	Route setting program	15
1410	Route summary management portion	
1451	Plan type system information management portion	
1452	Trackside facilities information management portion	20
1460	Communication management portion	
1471	Input interface	
1472	Output interface	
9900	Route setting device	
9910	Plan type system	25
9920	Ground device	
9930	Train	
9940	Trackside facilities	

Claims

1. A route setting program generation method for generation of a route setting program which issues a control command to trackside facilities to perform the route setting of trains by a route setting program generation device, comprising:

a step in which a track layout input portion of the route setting program generation device accepts track layout information on a railway that is comprised of a plurality of routes,

a step in which one of a predetermined plurality of geometric pattern types is used by a geometric pattern extracting portion of the route setting program generation device to define a geometrical relation between the two routes of each of the plurality of routes for each of combinations of two routes comprising the other one route configuring the track layout,

a step in which a route setting logic selection portion of the route setting program generation device selects a logic, which is used for judgment of enterable or not of a train into one of the two routes for each of the combinations of the two routes, based on a geometric pattern type defined for the combinations of the two routes, and

a step in which a program module connection portion of the route setting program generation device generates the route setting program by connecting a plurality of program modules identified by a plurality of logics selected by the route setting logic selection portion.

2. The route setting program generation method according to claim 1, wherein:

a geometrical relation between two routes is classified for the two routes on the basis of a standard for overlap of an end point of one route and an end point of the other route, a standard for an end point of the other route included in the one route, and a standard for an entering direction of the train into each route, and the geometric pattern extracting portion selects a geometric pattern type indicating a geometrical relation between the two routes for each of the combinations of the two routes according to the plurality of standards.

3. The route setting program generation method according to claim 2, wherein:

the route setting program generation device is provided with a plurality of route setting logics, the plurality of route setting logics each are classified to any of three types, a route determination logic type, a train priority determination logic type, and a collision/derailment prevention logic type, and necessary route setting logic types are defined for the plurality of geometric pattern types each according to the standard fulfilled by the geometric pattern types, and the route setting logic selection portion selects, from the plurality of route setting logics, a route setting logic belonging to a route setting logic type which is defined to be necessary for a geometric pattern type selected for the combination of the two routes for each of the combinations of the two routes.

4. The route setting program generation method according to claim 3, further comprising:

a step in which for each of the combinations of the two routes, a geometric pattern type selected for the combinations of the two routes is shown.

5. The route setting program generation method according to claim 1, wherein:

the track layout input portion:

accepts, as track layout information, track shape information which shows component

elements of the railway as one or more line segments, and route shape information which shows component elements of the route for each of the plurality of routes as a gathering of line segments included in the track shape information, and outputs an error message if there is a line segment, which is not included in the route shape information on any route, among the line segments contained in the track shape information.

6. A train route setting device for performing train route setting by issuing a control command to trackside facilities, comprising:

a memory which stores route information which registers, for each of a plurality of routes configuring a railway, a geometrical relation between the route and each of one or more other routes configuring the railway, identification information of two routes configuring the geometrical relation for each geometrical relation, and geometric information which has registered a geometric pattern type showing to which of a predetermined plurality of geometric pattern types the geometrical relation is classified, and a route setting logic selected for the geometrical relation based on the geometric pattern type, and a route reservation management portion which judges enterable or not of the train into a route to be processed, wherein:

the route reservation management portion: specifies one or more geometrical relations between the route to be processed and another route for the route to be processed according to the route information, and judges enterable or not of a train into the route to be processed for each specified geometrical relation on the basis of an on-rail state or an entry schedule of a train into another route configuring the geometrical relation by using the route setting logic registered for the geometrical relation.

7. The train route setting device according to claim 6, wherein:

the geometrical relation is classified, for two routes configuring the geometrical relation, on the basis of a standard for overlap of an end point of one route and an end point of the other route, a standard for an end point of the other route included in one route, and a standard for an entry direction of a train into each route, and the geometric information registers the route setting logic selected on the basis of the geo-

metric pattern type of each geometrical relation determined according to the classification.

8. The train route setting device according to claim 7, wherein:

the route setting logic is classified to any of three types of a route determination logic type, a train priority determination logic type, and a collision/derailment prevention logic type, a type of the necessary route setting logic is defined for each of the geometric pattern type according to the standard fulfilled by the geometric pattern type, and the geometric information registers for each geometrical relation a route setting logic belonging to the route setting logic type, which is defined to be necessary for the geometric pattern type of the geometrical relation.

FIG. 1A

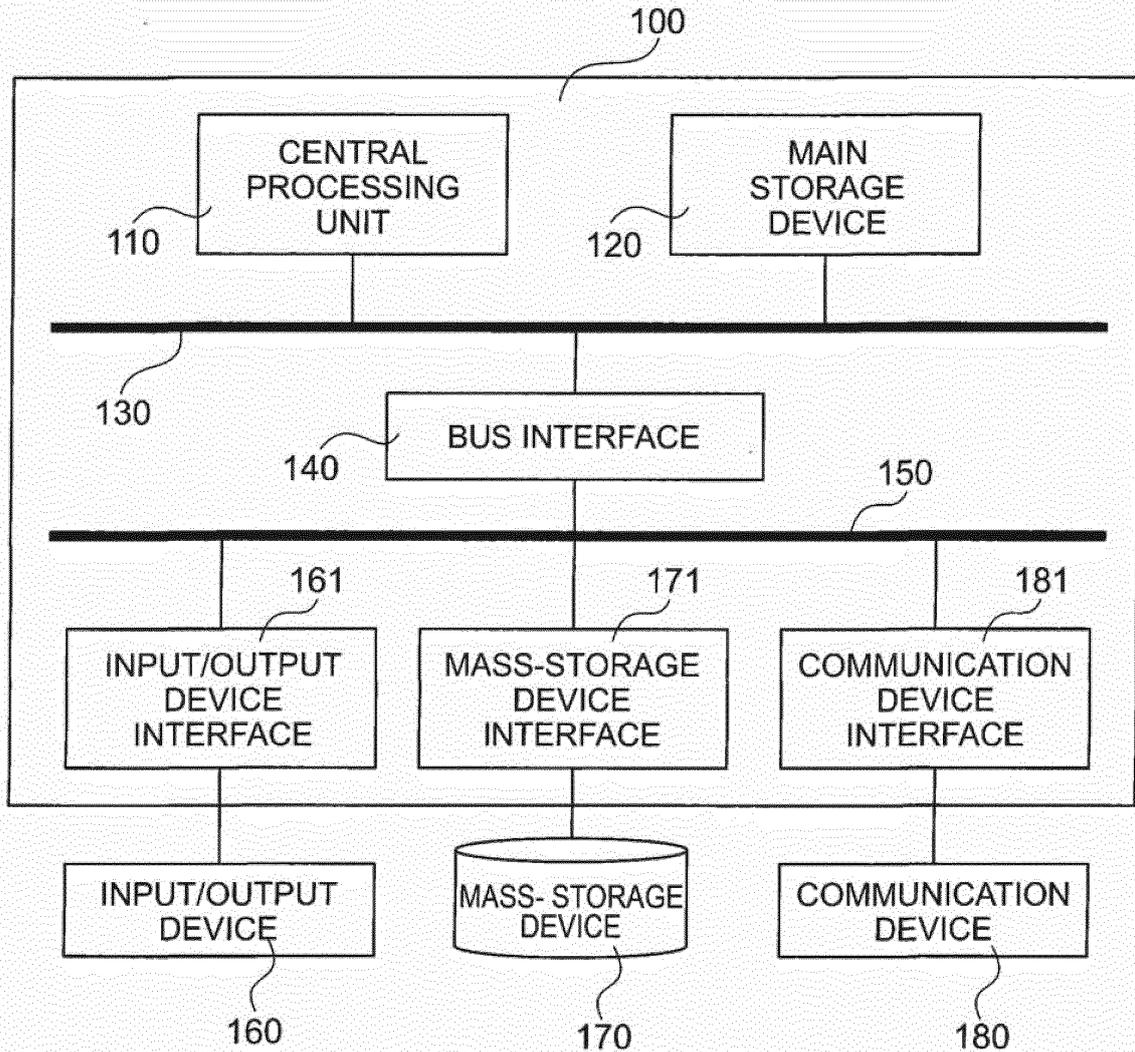


FIG. 1B

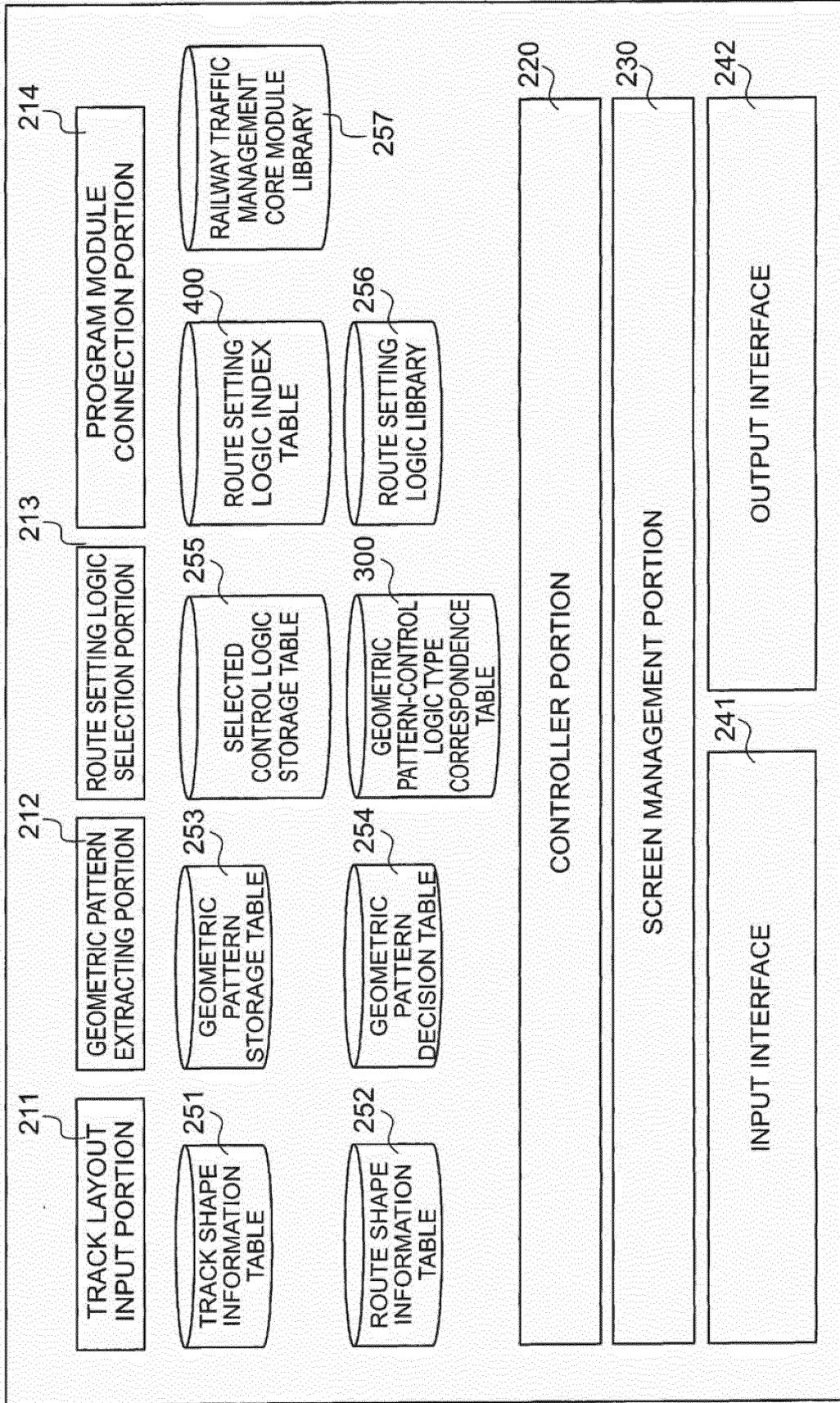


FIG. 2A

TRACK SHAPE INFORMATION TABLE

RAILWAY ELEMENT ID	STATION NAME	START COORDINATES	END COORDINATES
Line_#1	ITAZUKE	(0,0)	(1,0)
Line_#2	ITAZUKE	(1,0)	(5,0)
Line_#3	ITAZUKE	(1,0)	(3,2)
Line_#4	ITAZUKE	(3,2)	(5,2)
...

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FIG. 2B

ROUTE SHAPE INFORMATION TABLE

ROUTE ID	START POINT COORDINATE	END POINT COORDINATE	CORRESPONDING RAILWAY ELEMENT ID	DIRECTION	NEIGHBORING STATION BORDER
Block_#1	(0,0)	(5,0)	Line_#1,Line_#2	INBOUND	START POINT
Block_#2	(0,0)	(5,2)	Line_#3,Line_#4	INBOUND	START POINT
...

252

FIG. 2C

GEOMETRIC PATTERN STORAGE TABLE

GEOMETRIC PATTERNS ID	GEOMETRIC PATTERN TYPE	ROUTE 1ID	ROUTE 2ID
Topology_#1	16	Block_#1	Block_#2
Topology_#2	12	Block_#1	Block_#3
Topology_#3	19	Block_#3	Block_#4
...

253

FIG. 2D

SELECTED ROUTE SETTING LOGIC STORAGE TABLE

GEOMETRIC PATTERN ID	RESERVATION TARGET ROUTE SELECTION LOGIC	TRAIN PRIORITY DETERMINATION LOGIC	ROUTE CHECK LOGIC (ROUTE 1→ROUTE 2)	ROUTE CHECK LOGIC (ROUTE 2→ROUTE 1)
Topology_#1	Logic_#A1	—	—	—
Topology_#3	—	Logic_#B1	Logic_#C1	Logic_#C2
...

255

FIG. 2E

GEOMETRIC PATTERN DECISION TABLE

No.	GEOMETRIC PATTERN CLASSIFICATION STANDARD						DIRECTIONAL RELATION BETWEEN ROUTES 1 AND 2	GEOMETRIC PATTERN TYPE
	NUMBER OF OVERLAP END POINTS	OVERLAP END POINT TYPE	NUMBER OF END POINTS INCLUDED IN ROUTE 1	END POINT TYPE OF ROUTE 1 INCLUDED IN ROUTE 2	NUMBER OF END POINTS INCLUDED IN ROUTE 2	TYPE OF END POINTS OF ROUTE 1 INCLUDED IN ROUTE 2		
1			0	NONE	0	NONE	FORWARD DIRECTION	(1) CROSSING A
2							REVERSE DIRECTION	(2) CROSSING B
3			1	START POINT			FORWARD DIRECTION	(3) START POINT BLOCKADE A
4					0		REVERSE DIRECTION	(4) START POINT BLOCKADE B
5	0 END POINT			END POINT			FORWARD DIRECTION	(5) END POINT BLOCKADE A
6	POINT						REVERSE DIRECTION	(6) END POINT BLOCKADE B
7	OVERLAP	NONE		START POINT		END POINT	FORWARD DIRECTION	(7) START-END ALTERNATE POINT BLOCKADE
8			1	START POINT		START POINT	REVERSE DIRECTION	UNREALIZABLE
9					1		FORWARD DIRECTION	UNREALIZABLE
10				END POINT		END POINT	REVERSE DIRECTION	(8) DEADLOCK B
11							FORWARD DIRECTION	UNREALIZABLE
12			2	BOTH			FORWARD DIRECTION	(9) BOTH END POINT BLOCKAGE C
13					0	NONE	REVERSE DIRECTION	(10) START-END POINT BLOCKAGE A
14			0	NONE		NONE	FORWARD DIRECTION	(11) START-END POINT BLOCKAGE B
15		END POINT OF ROUTE 1 AND START POINT OF ROUTE 2 (OR START POINT OF ROUTE 1 AND END POINT OF ROUTE 2)		START POINT		NONE	FORWARD DIRECTION	(12) FORWARD DIRECTION CONNECTION
16			1	END POINT		NONE	REVERSE DIRECTION	(13) REVERSE DIRECTION CONNECTION A
17	1 END POINT			START POINT		NONE	FORWARD DIRECTION	UNREALIZABLE
18	POINT			END POINT		NONE	REVERSE DIRECTION	(14) REVERSE DIRECTION CONNECTION B
19	OVERLAP				0	NONE	FORWARD DIRECTION	UNREALIZABLE
20		START POINT OF ROUTE 1 AND START POINT OF ROUTE 2		NONE		NONE	REVERSE DIRECTION	(15) REVERSE DIRECTION CONNECTION C
21			0	NONE		NONE	FORWARD DIRECTION	(16) ROUTE SELECTION A
22			1	END POINT		NONE	REVERSE DIRECTION	(17) ROUTE SELECTION B
23		END POINT OF ROUTE 1 AND END POINT OF ROUTE 2			0	NONE	FORWARD DIRECTION	(18) ROUTE SELECTION C
24			0	NONE		NONE	REVERSE DIRECTION	UNREALIZABLE
25		START POINT OF ROUTE 1 AND END POINT OF ROUTE 2			0	NONE	FORWARD DIRECTION	(19) BOTH END POINT BLOCKAGE A
26			1	START POINT		NONE	REVERSE DIRECTION	(20) BOTH END POINT BLOCKAGE B
27					0	NONE	FORWARD DIRECTION	(21) START-END POINT BLOCKAGE C
28			1	END POINT		NONE	REVERSE DIRECTION	UNREALIZABLE
29		START POINT OF ROUTE 1 AND END POINT OF ROUTE 2 AND START POINT OF ROUTE 2 AND END POINT OF ROUTE 1	0	NONE	0	NONE	FORWARD DIRECTION	UNREALIZABLE
30	2 END POINT			NONE		NONE	REVERSE DIRECTION	(22) DEADLOCK A
31	POINT		0	NONE		NONE	FORWARD DIRECTION	ROUTE 1 AND ROUTE 2 ARE SAME
32	OVERLAP				0	NONE	REVERSE DIRECTION	UNREALIZABLE

FIG. 3A

(1) CROSSING A

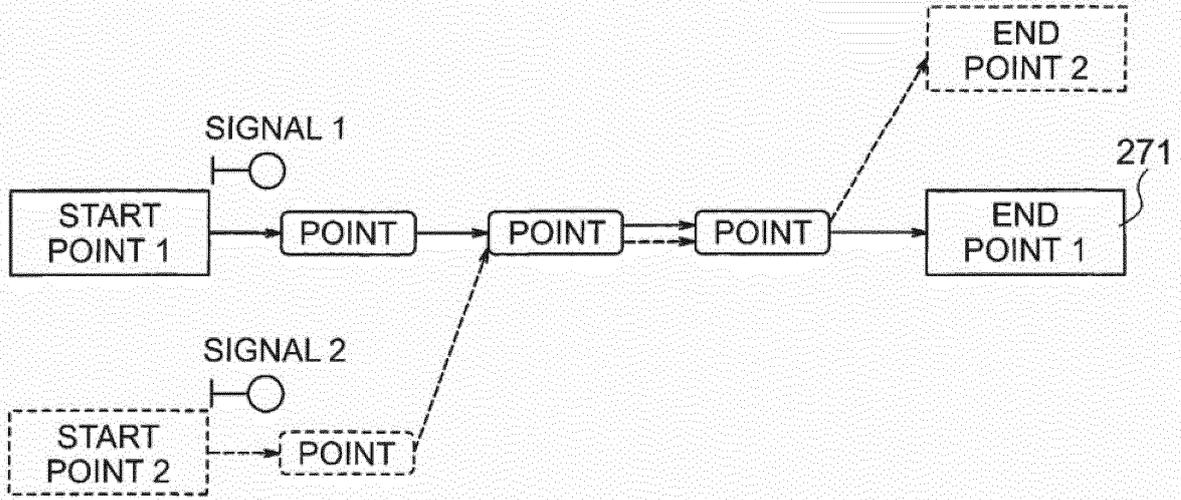


FIG. 3B

(2) CROSSING B

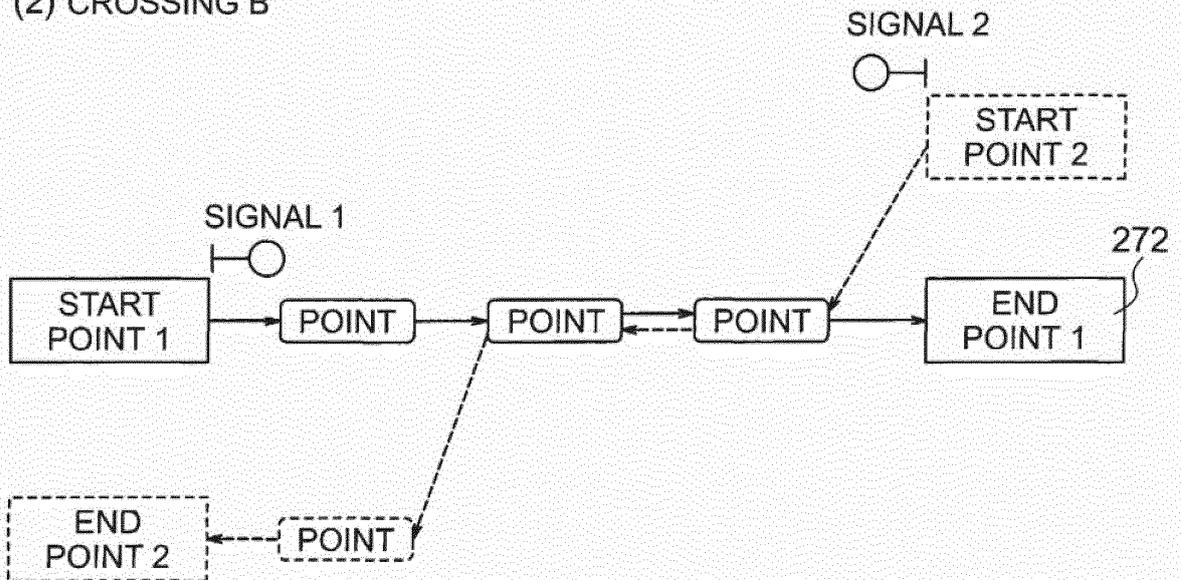


FIG. 3C

(3) START POINT BLOCKADE A

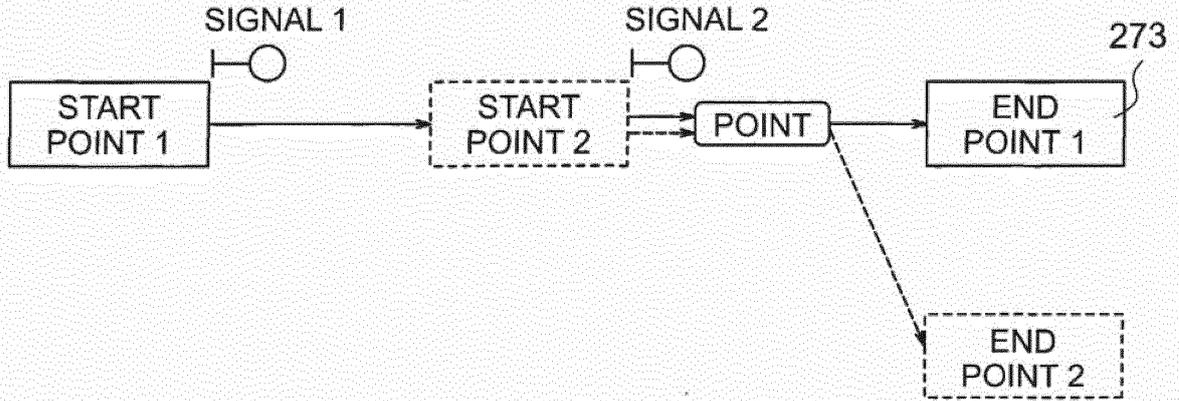


FIG. 3D

(4) START POINT BLOCKADE B

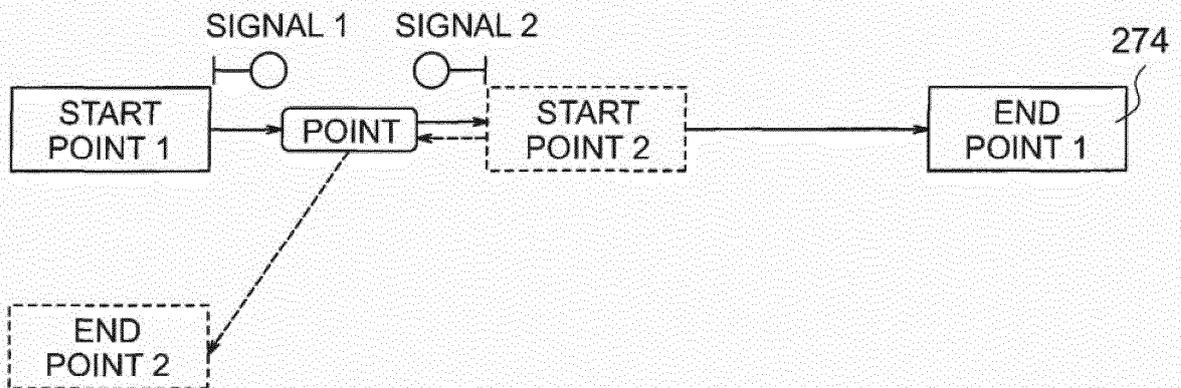


FIG. 3E

(5) END POINT BLOCKADE A

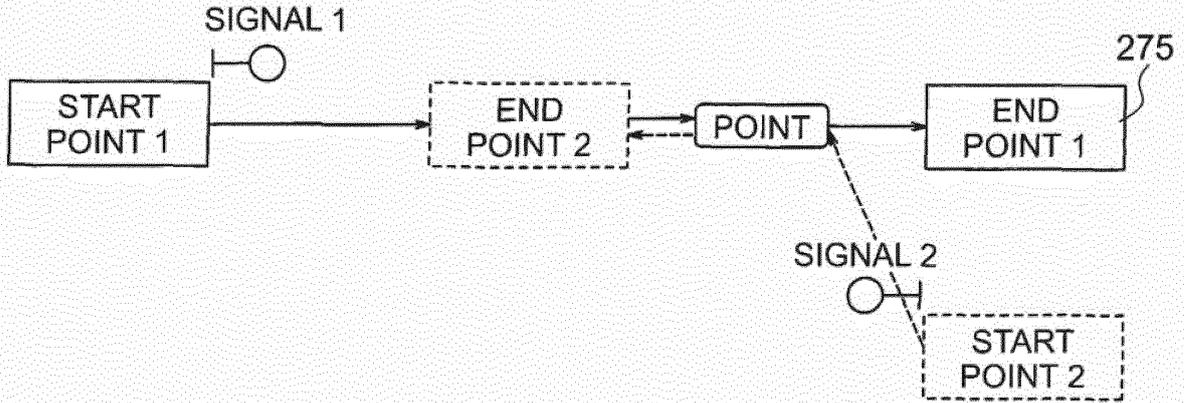


FIG. 3F

(6) END POINT BLOCKADE B

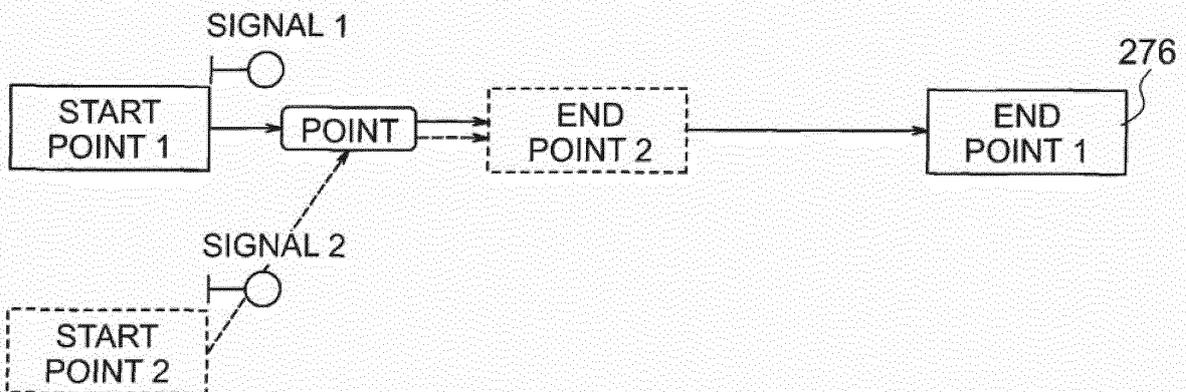


FIG. 3G

(7) START-END ALTERNATE POINT BLOCKADE

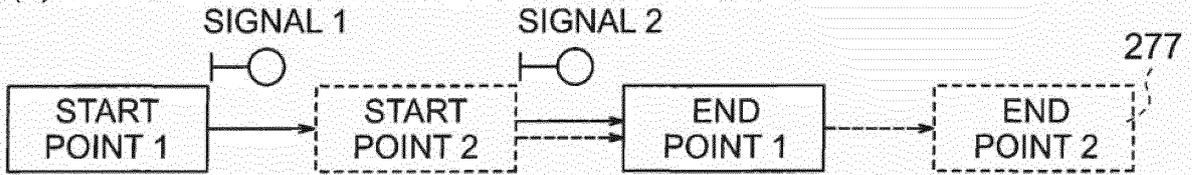


FIG. 3H

(8) DEADLOCK B

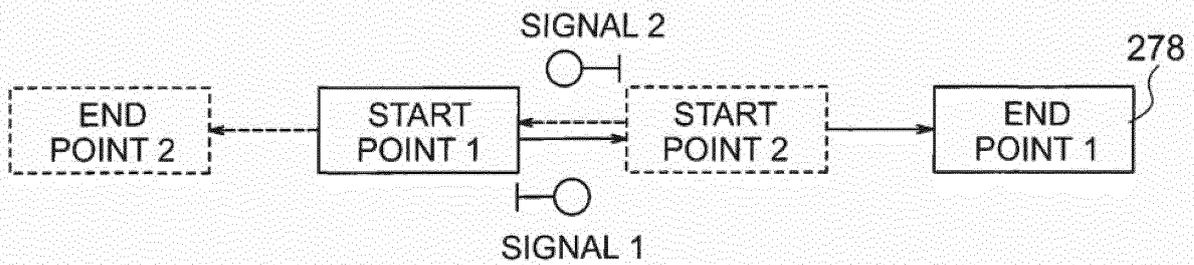


FIG. 3I

(9) BOTH END POINT BLOCKAGE C

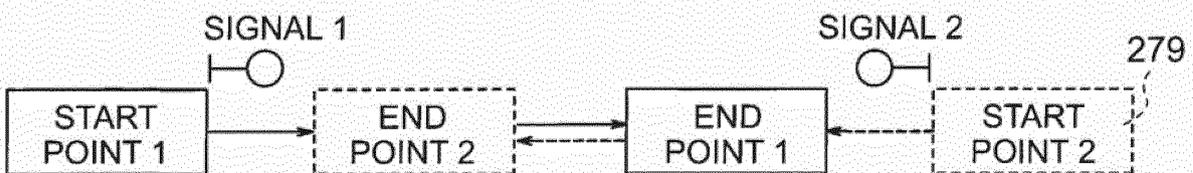


FIG. 3J

(10) START-END POINT BLOCKAGE A

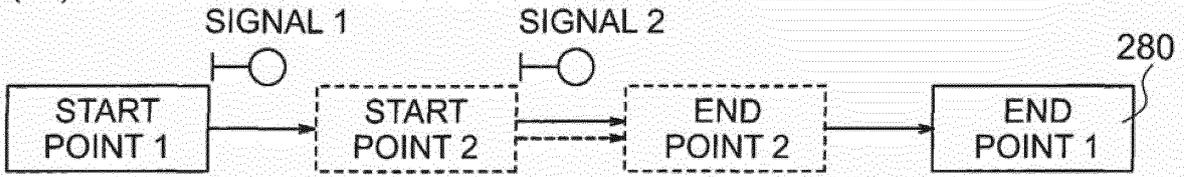


FIG. 3K

(11) START-END POINT BLOCKAGE B

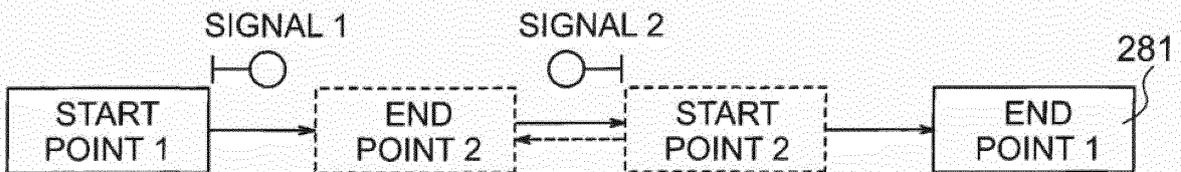


FIG. 3L

(12) FORWARD DIRECTION CONNECTION

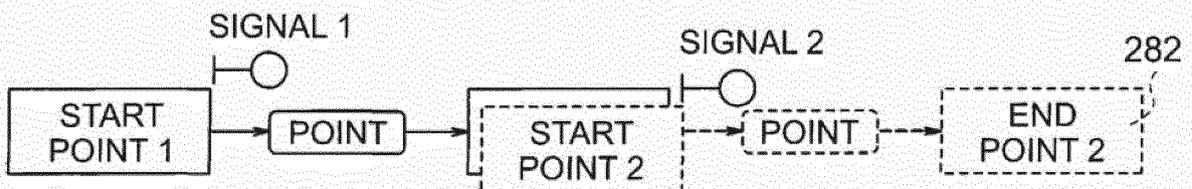


FIG. 3M

(13) REVERSE DIRECTION CONNECTION A

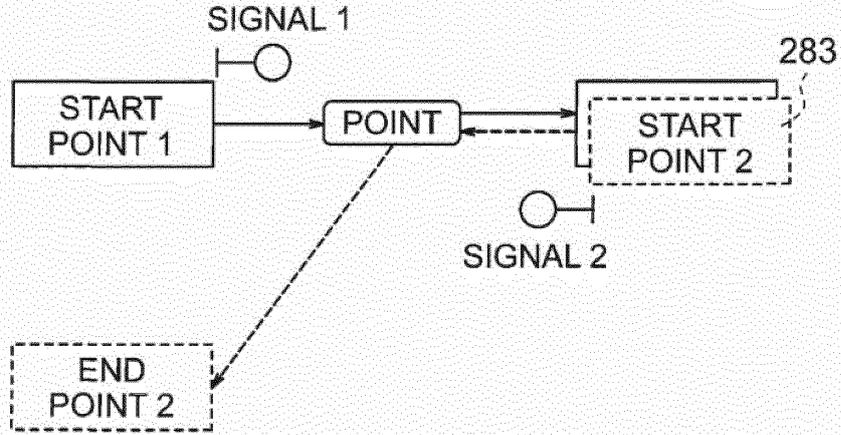


FIG. 3N

(14) REVERSE DIRECTION CONNECTION B

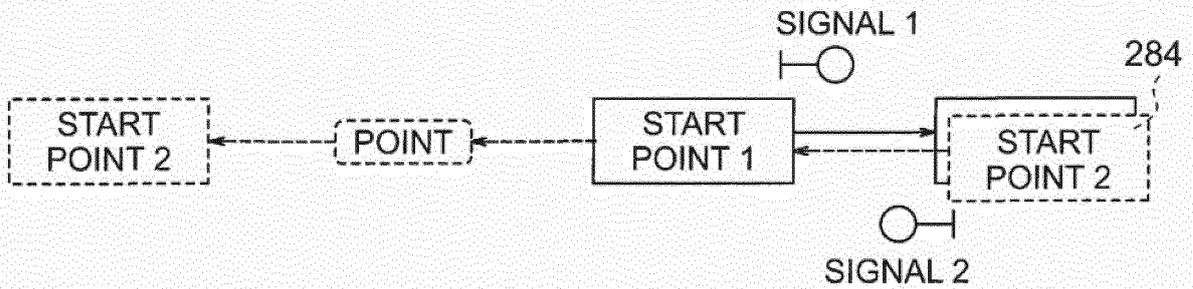


FIG. 30

(15) REVERSE DIRECTION CONNECTION C

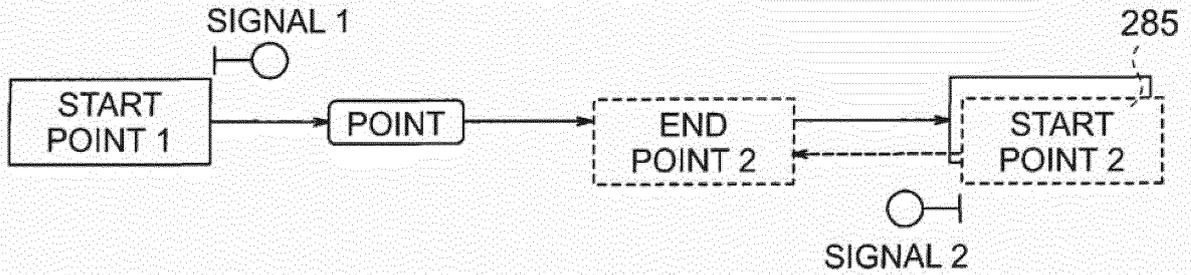


FIG. 3P

(16) ROUTE SELECTION A

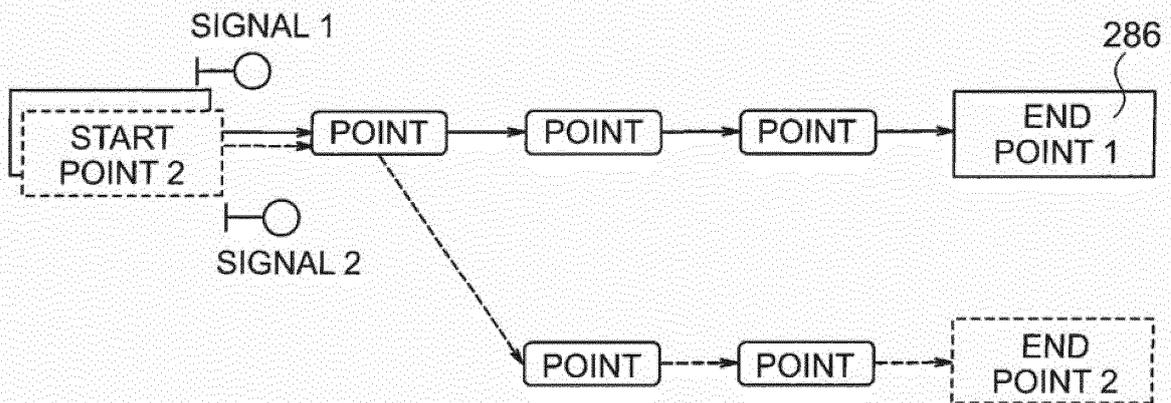


FIG. 3Q

(17) ROUTE SELECTION B

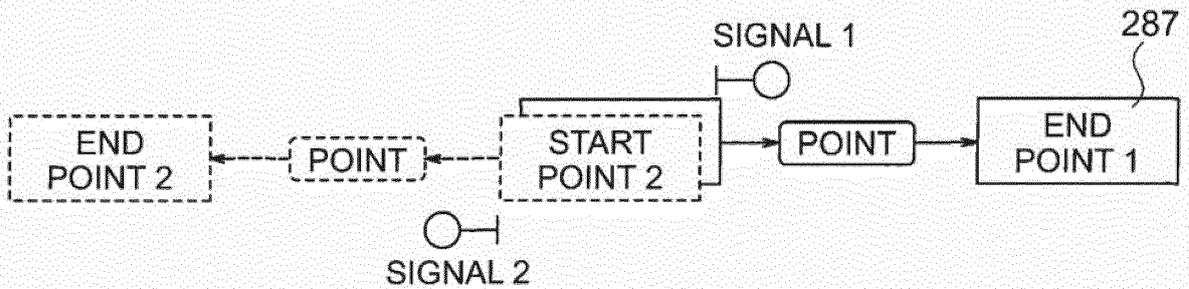


FIG. 3R

(18) ROUTE SELECTION C

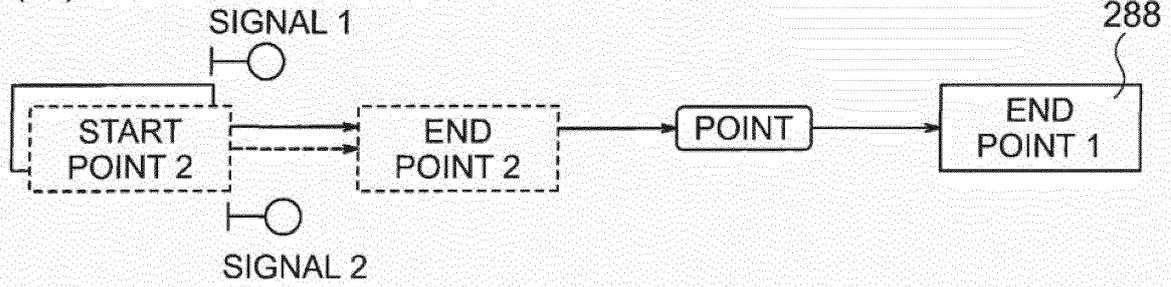


FIG. 3S

(19) BOTH END POINT BLOCKAGE A

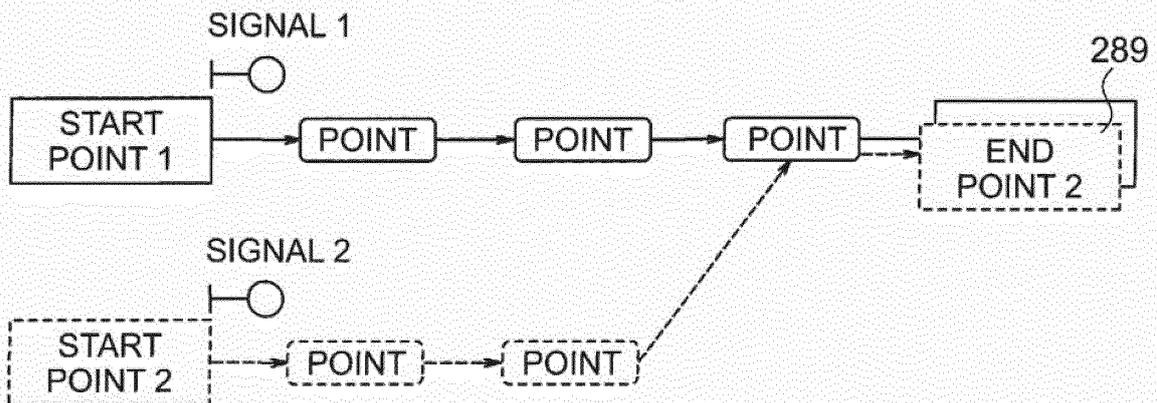


FIG. 3T

(20) BOTH END POINT BLOCKAGE B

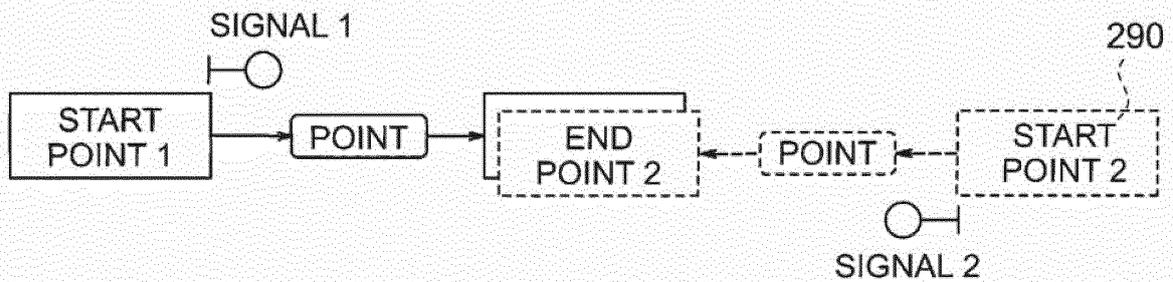


FIG. 3U

(21) START-END POINT BLOCKAGE C

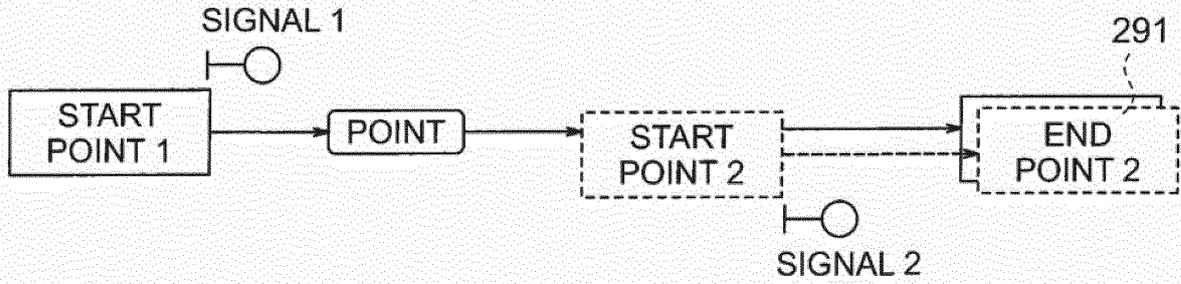


FIG. 3V

(22) DEADLOCK A

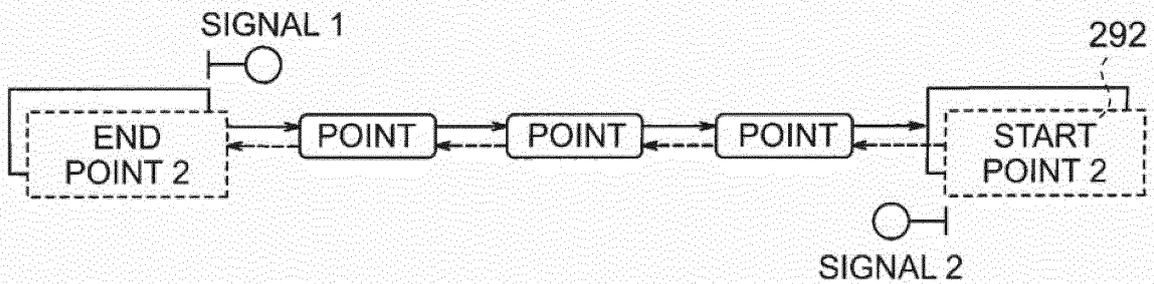


FIG. 4A

300

GEOMETRIC PATTERN-ROUTE SETTING LOGIC TYPE CORRESPONDENCE TABLE

No.	GEOMETRIC PATTERN TYPE	ROUTE SETTING LOGIC TYPE		
		RESERVATION TARGET ROUTE SELECTION	TRAIN PRIORITY DETERMINATION	ROUTE CHECK
(1)	CROSSING A	x	o	o
(2)	CROSSING B	x	o	o
(3)	START POINT BLOCKADE A	x	x	o
(4)	START POINT BLOCKADE B	x	x	o
(5)	END POINT BLOCKADE A	x	o	o
(6)	END POINT BLOCKADE B	x	o	o
(7)	START-END ALTERNATE POINT BLOCKADE	x	x	x
(8)	DEADLOCK B	x	x	x
(9)	BOTH END POINT BLOCKAGE C	x	o	o
(10)	START-END POINT BLOCKAGE A	x	x	x
(11)	START-END POINT BLOCKAGE B	x	x	x
(12)	FORWARD DIRECTION CONNECTION	o	x	x
(13)	REVERSE DIRECTION CONNECTION A	o	x	o
(14)	REVERSE DIRECTION CONNECTION B	o	x	x
(15)	REVERSE DIRECTION CONNECTION C	o	x	x
(16)	ROUTE SELECTION A	o	x	o
(17)	ROUTE SELECTION B	o	x	x
(18)	ROUTE SELECTION C	o	x	x
(19)	BOTH END POINT BLOCKAGE A	x	o	o
(20)	BOTH END POINT BLOCKAGE B	x	o	o
(21)	START-END POINT BLOCKAGE C	x	x	x
(22)	DEADLOCK A	x	x	x

FIG. 4B

ROUTE SETTING LOGIC INDEX TABLE

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ROUTE SETTING LOGIC TYPE	ROUTE SETTING LOGIC NAME	ROUTE SETTING LOGIC ID
RESERVATION TARGET ROUTE SELECTION	PRIORITY ROUTE SELECTION	Logic_#A1
	TIMETABLE ROUTE SELECTION	Logic_#A2
TRAIN PRIORITY DETERMINATION	TIMETABLE TIME SEQUENCE	Logic_#B1
	TRAIN POSITION SEQUENCE	Logic_#B2
ROUTE CHECK	ON-RAIL TRAIN CHECK	Logic_#C1
	TRAIN POSITION CHECK	Logic_#C2

FIG. 5

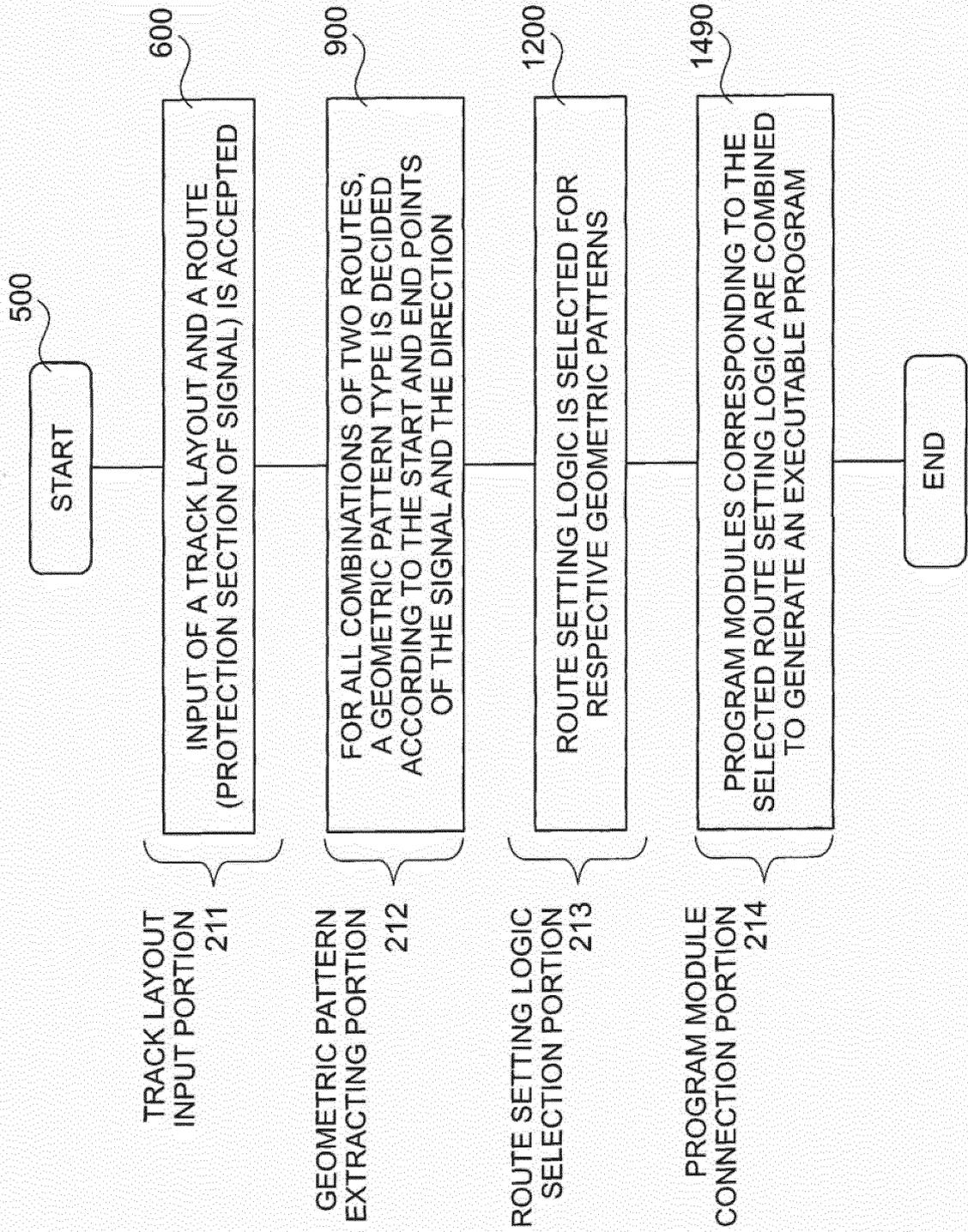


FIG. 6

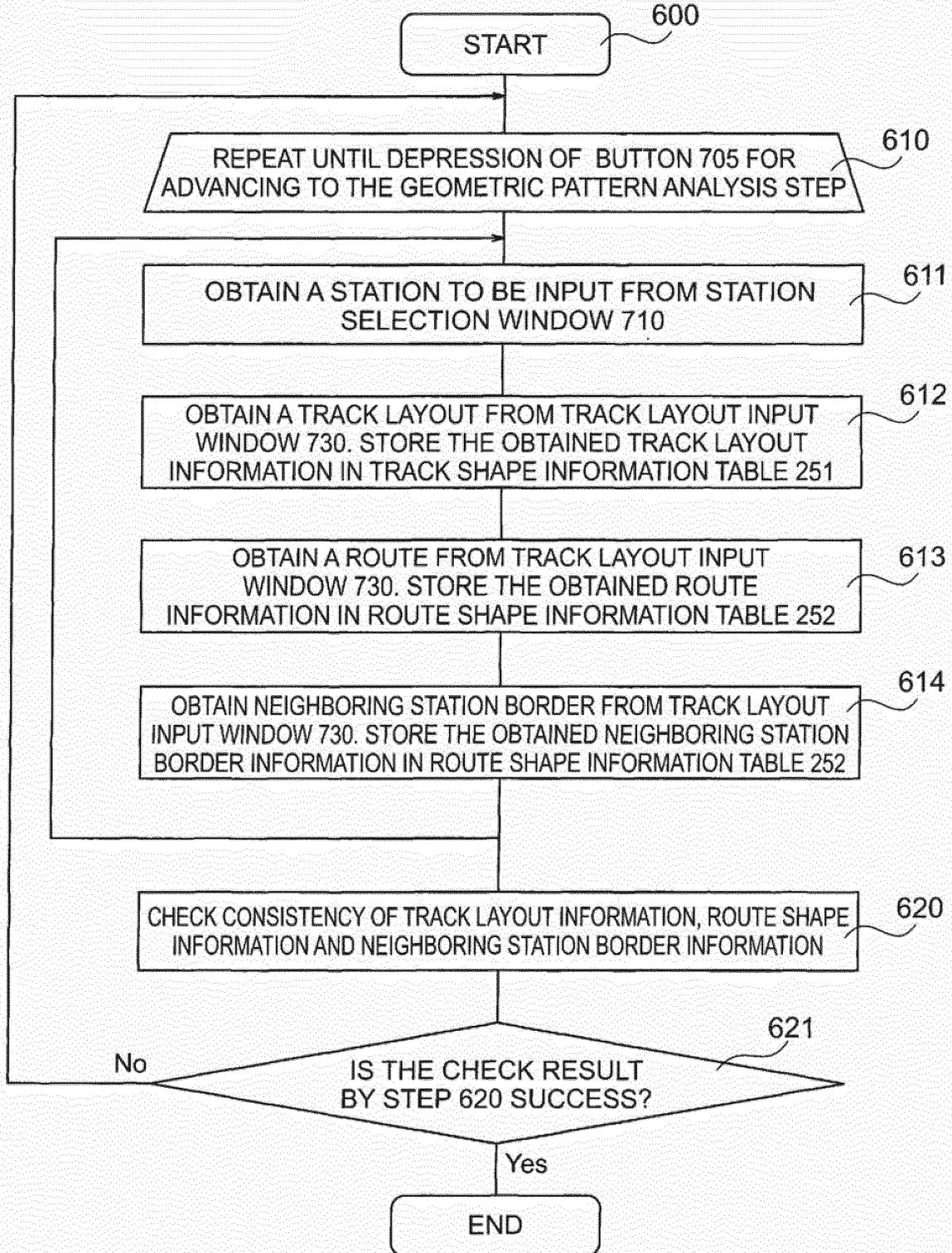


FIG. 7

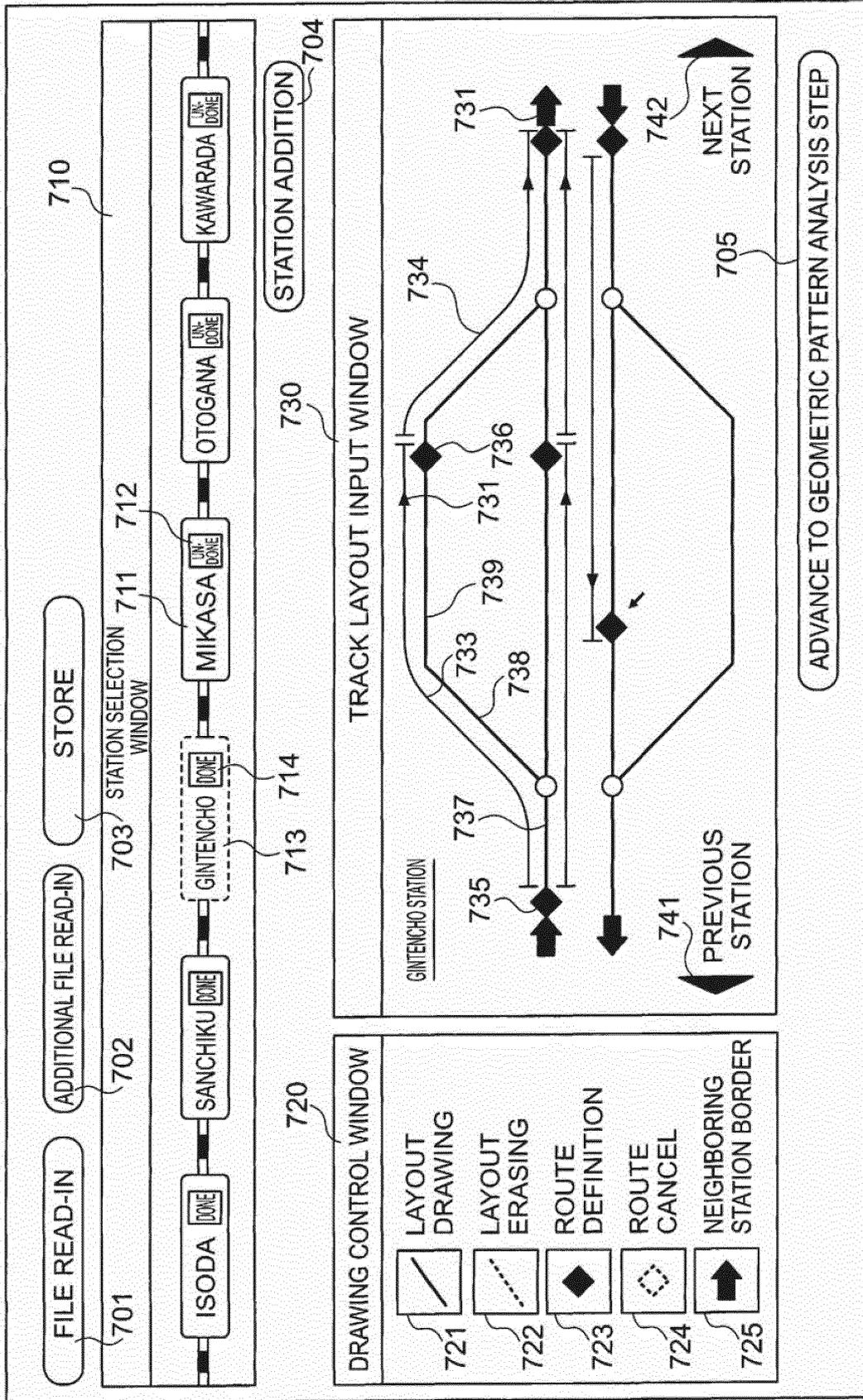


FIG. 8

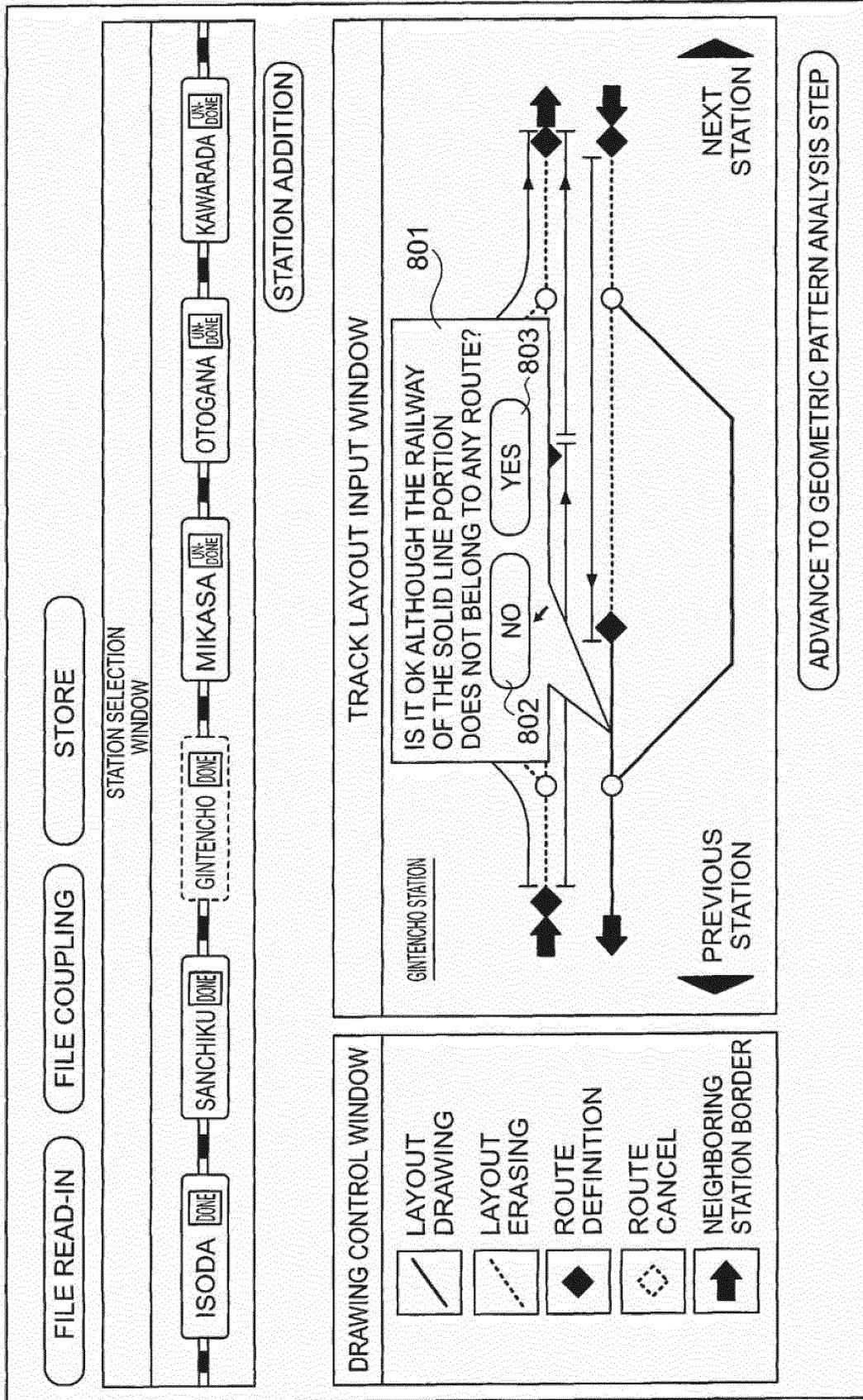


FIG. 9

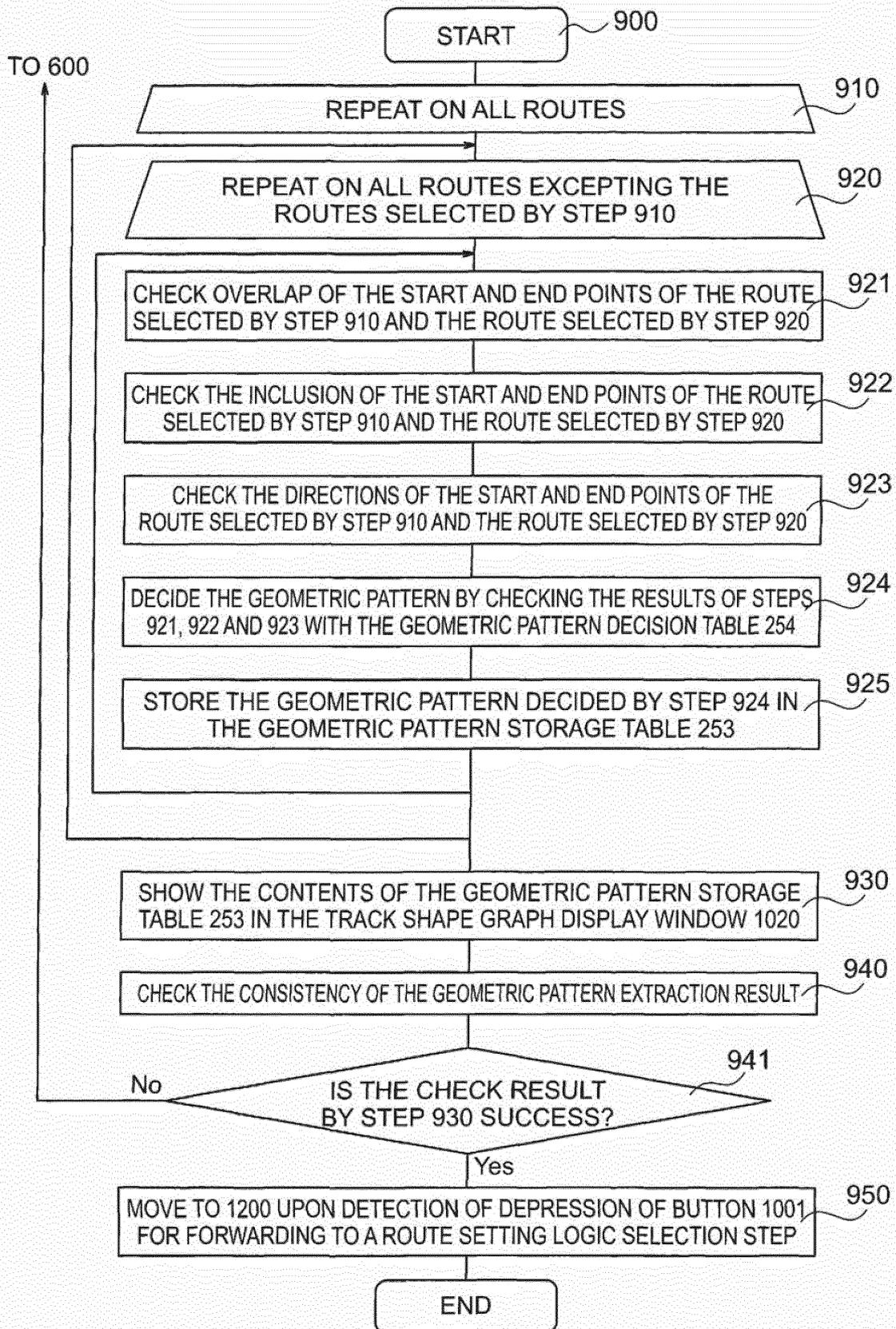


FIG. 10

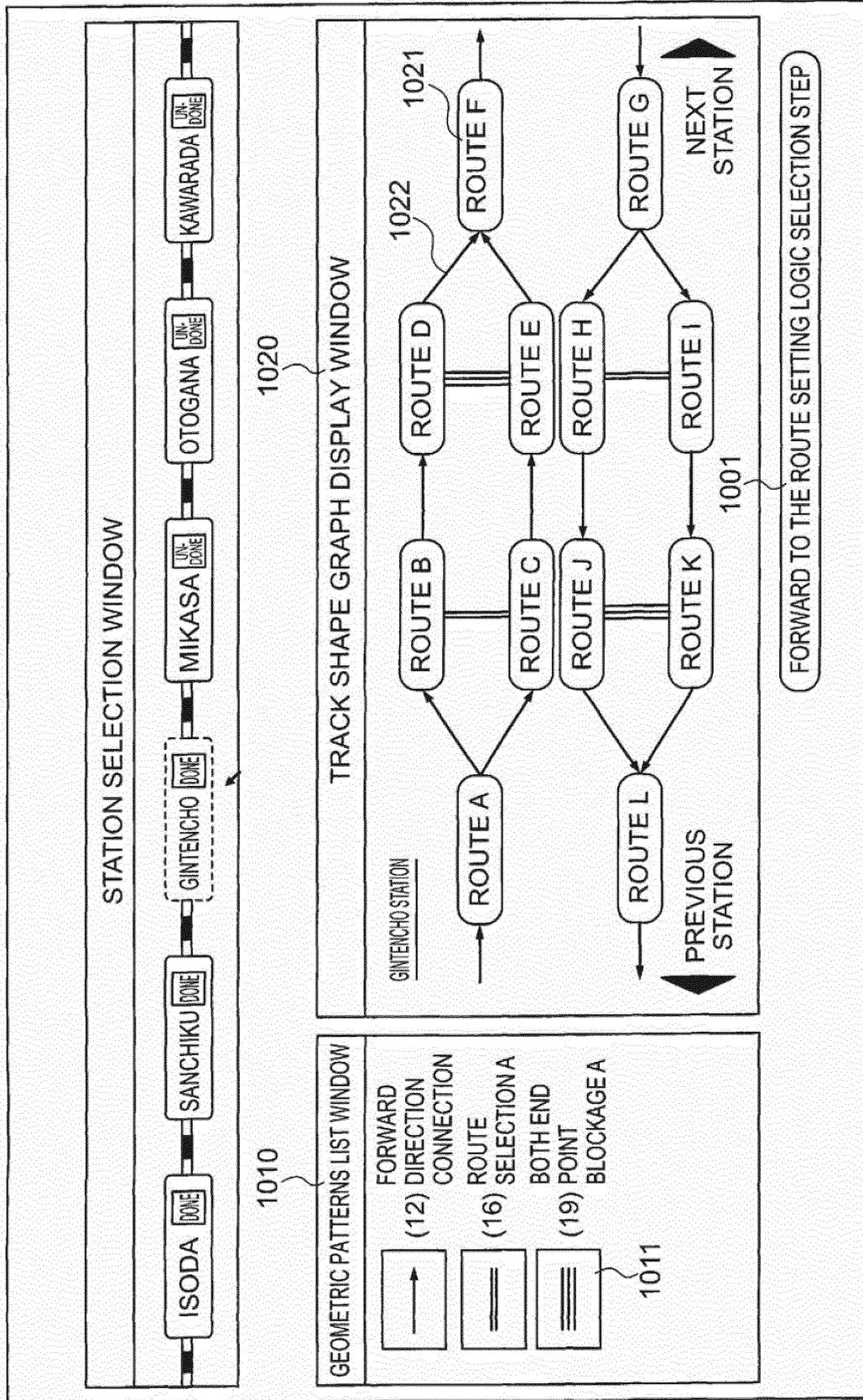


FIG. 11

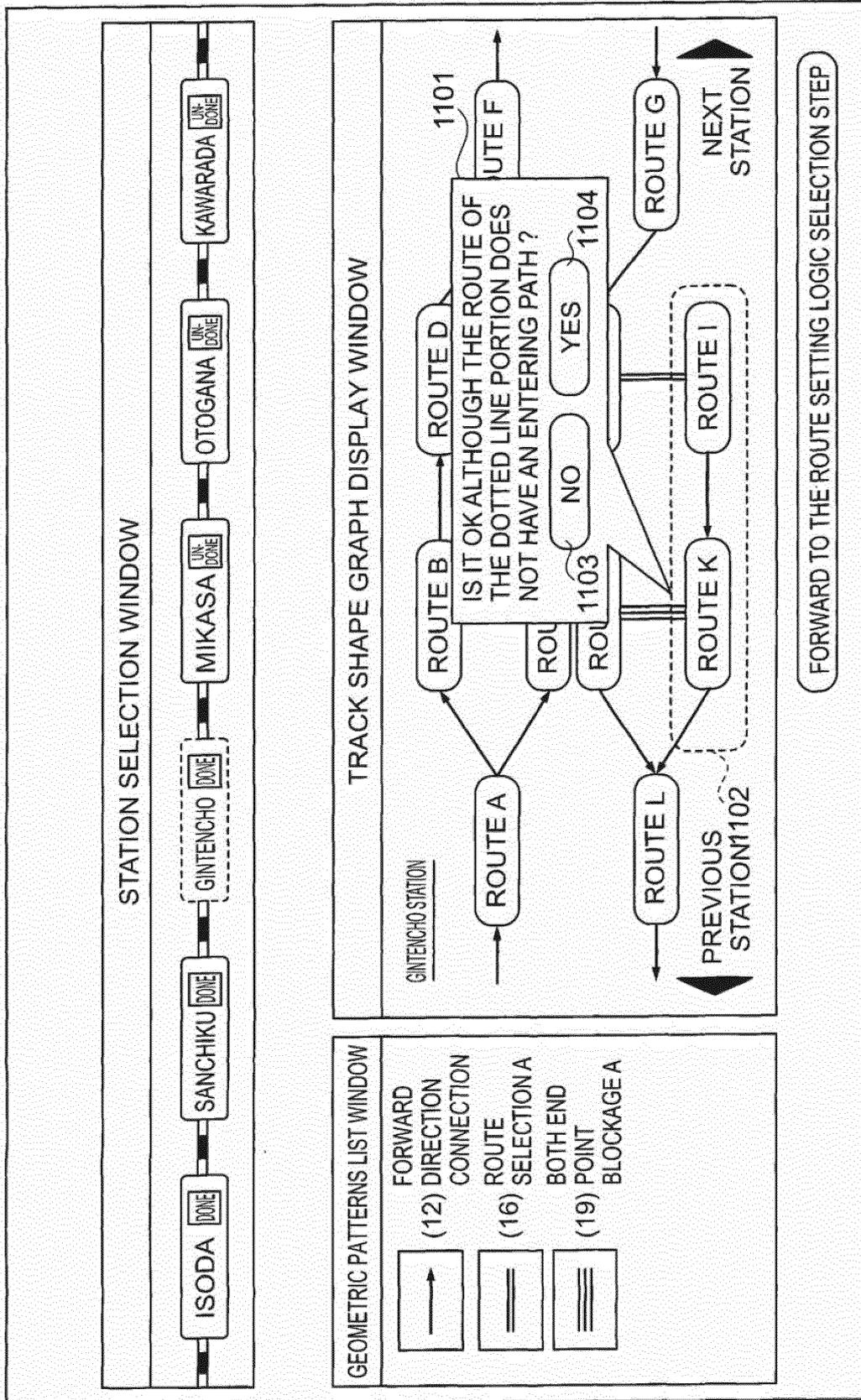


FIG. 12

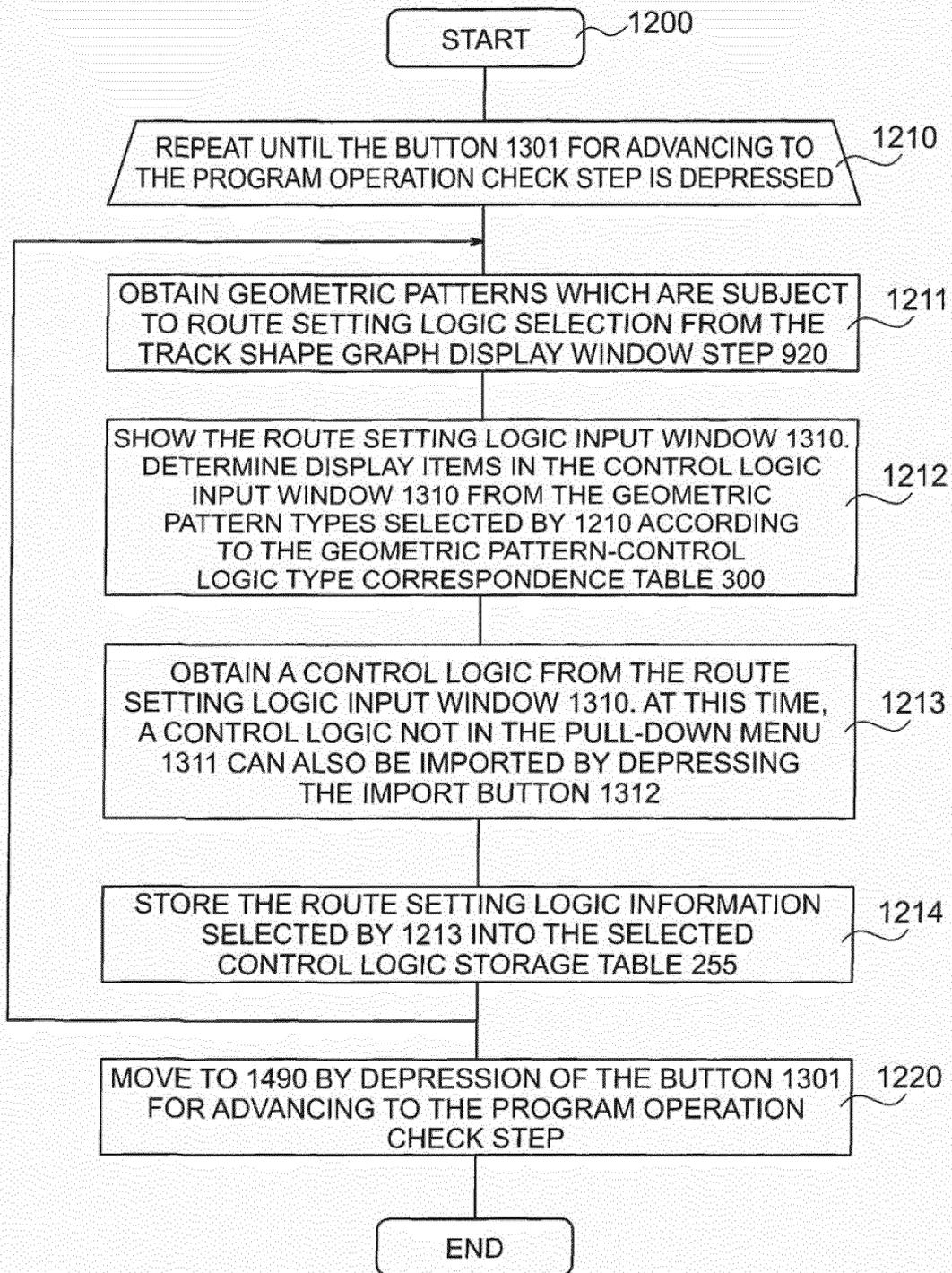


FIG. 13

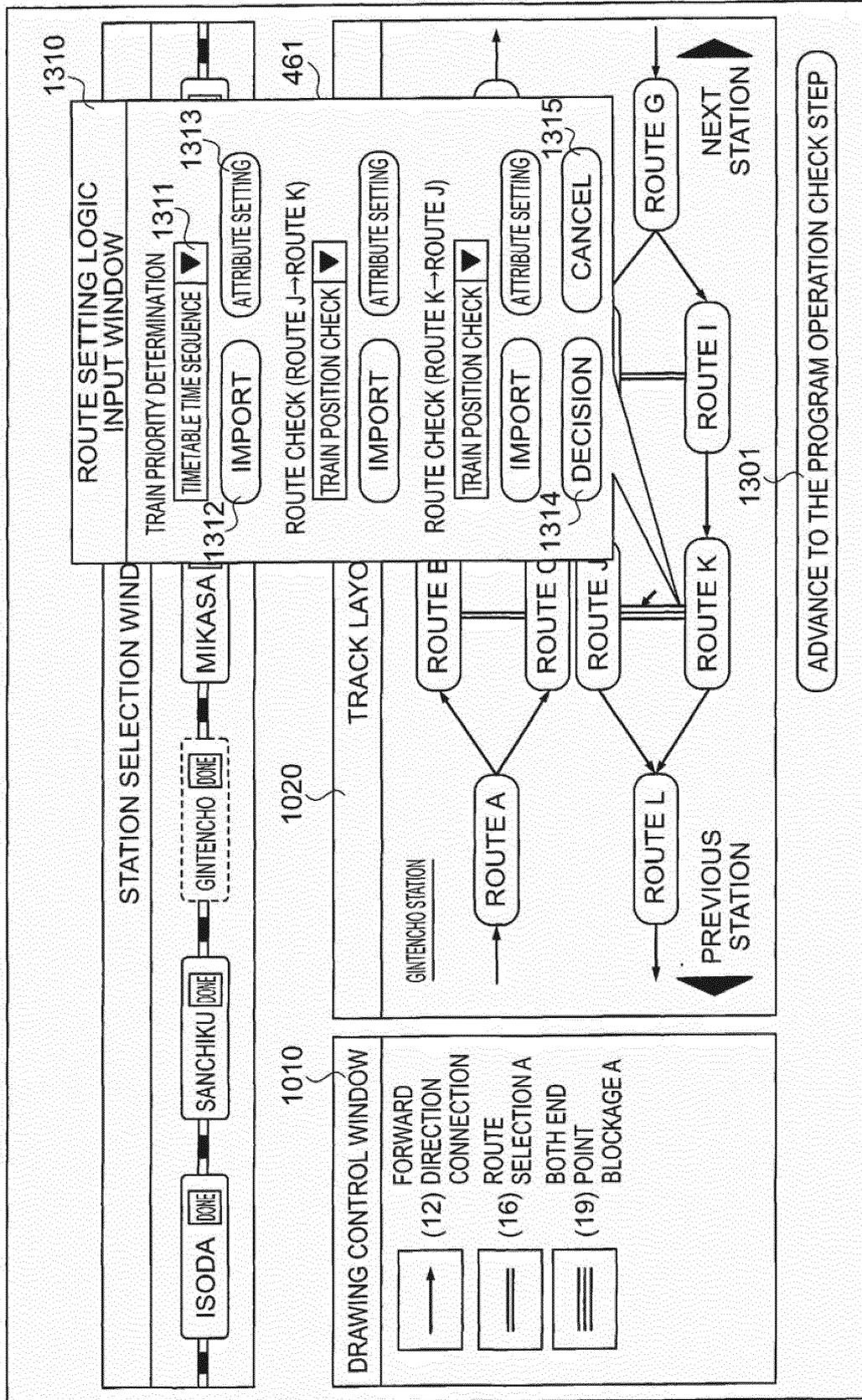


FIG. 14A

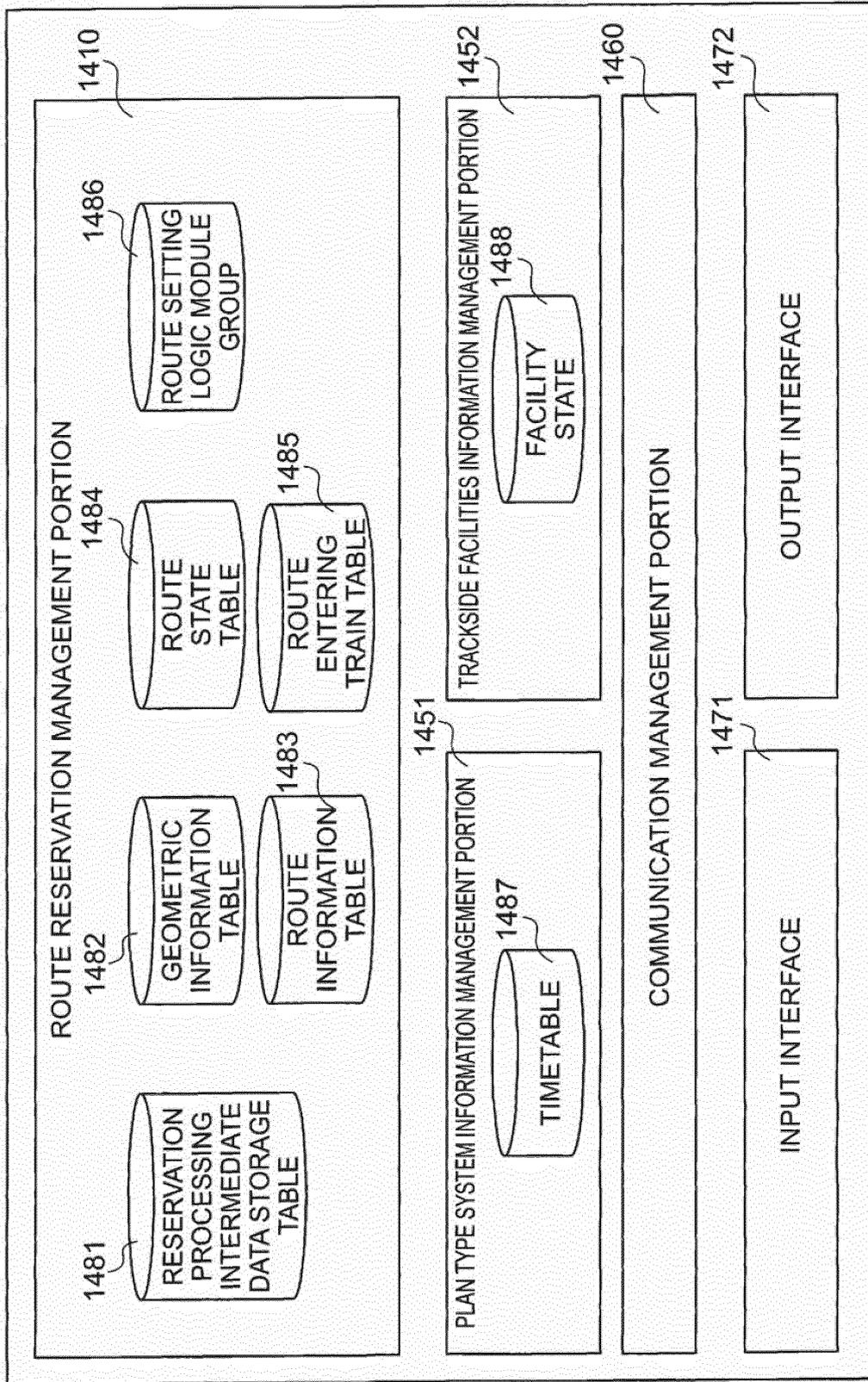


FIG. 14B

RESERVATION PROCESSING INTERMEDIATE DATA STORAGE TABLE

DATA TYPE	VALUE
RESERVATION REQUEST ROUTE	Block_1
RESERVATION TARGET ROUTE	Block_5
PREVIOUS RESERVATION TARGET ROUTE	Block_3

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FIG. 14C

GEOMETRIC INFORMATION TABLE

GEOMETRIC PATTERN ID	GEOMETRIC PATTERN TYPE	ROUTE 1 ID	ROUTE 2 ID	RESERVATION TARGET ROUTE SELECTION LOGIC	TRAIN PRIORITY DETERMINATION	ROUTE CHECK LOGIC (ROUTE 1 →ROUTE 2)	ROUTE CHECK LOGIC (ROUTE 2 →ROUTE 1)
Topology_1	16	Block_1	Block_2	Logic_A1	—	—	—
Topology_2	12	Block_1	Block_3	Logic_A2	—	—	—
Topology_3	19	Block_3	Block_4	—	Logic_B1	Logic_C1	Logic_C2
...

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FIG. 14D

ROUTE INFORMATION TABLE

ROUTE ID	GEOMETRIC PATTERN	STATION	RELATED FACILITIES
Block_1	Topology_1, Topology_2	ITAZUKE	SIGNAL 1R TRACK CIRCUIT 1T
Block_2	Topology_2, Topology_3	ITAZUKE	SIGNAL 2R TRACK CIRCUIT 2T
...

1483

FIG. 14E

ROUTE STATE TABLE

ROUTE ID	RESERVATION STATE	RESERVED TRAIN	ON-RAIL TRAIN	ON-RAIL TRAIN POSITION	ROUTE-INSIDE FACILITY STATE
Block_1	UNRESERVED	Train_1	—	—	UNAVAILABLE
Block_2	RESERVED	—	Train_2	AT THE EXIT BERTH	AVAILABLE
...

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FIG. 14F

ROUTE ENTERING TRAIN TABLE

ROUTE ID	ENTRY SCHEDULED TRAIN	NON-ENTERED/ENTERED
Block_1	Train_1 Train_3 Train_5	ENTERED NON-ENTERED NON-ENTERED
Block_2	Train_2 Train_4 Train_6	ENTERED ENTERED NON-ENTERED
...

1485

FIG. 14G

TRAIN TIMETABLE

TRAIN ID	ROUTES ON THE TRAIN PATH	ENTRANCE TIME
Train_1	Block_1	19:18:19
	Block_2	19:19:19
	Block_3	19:20:19
Train_2	Block_4	19:05:03
	Block_5	19:07:05
	Block_6	19:09:07
...

1487

FIG. 14H

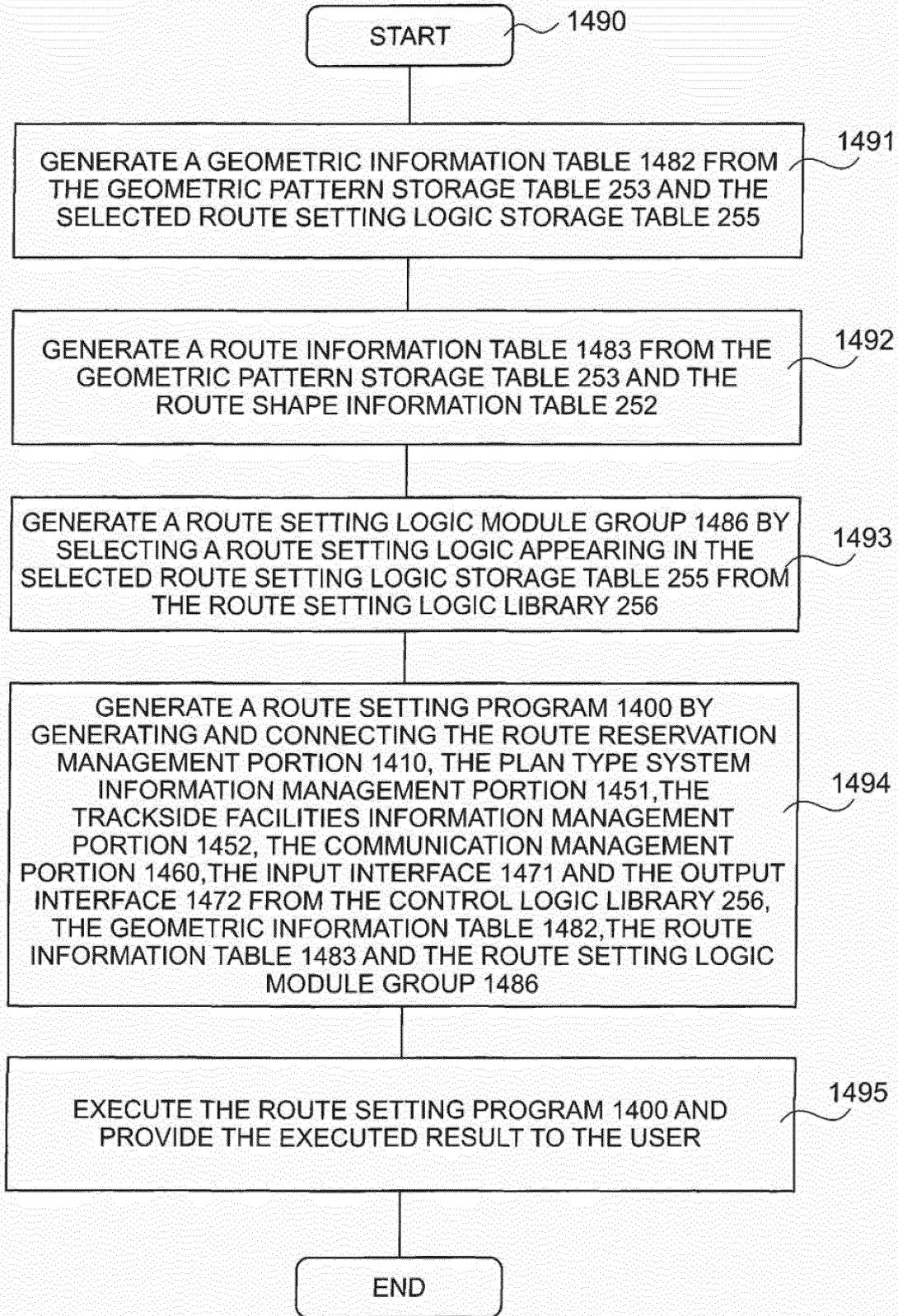


FIG. 15

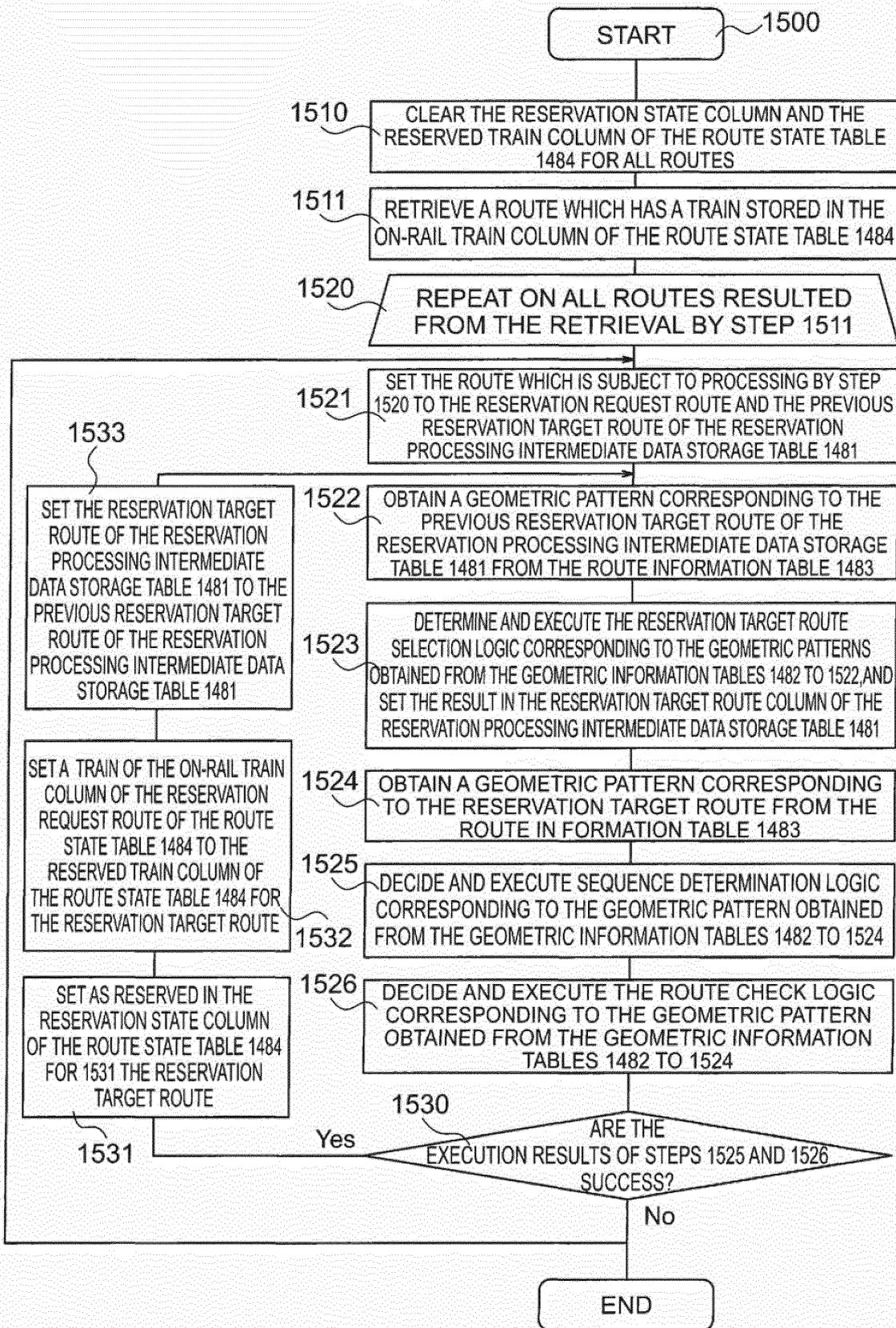


FIG. 16

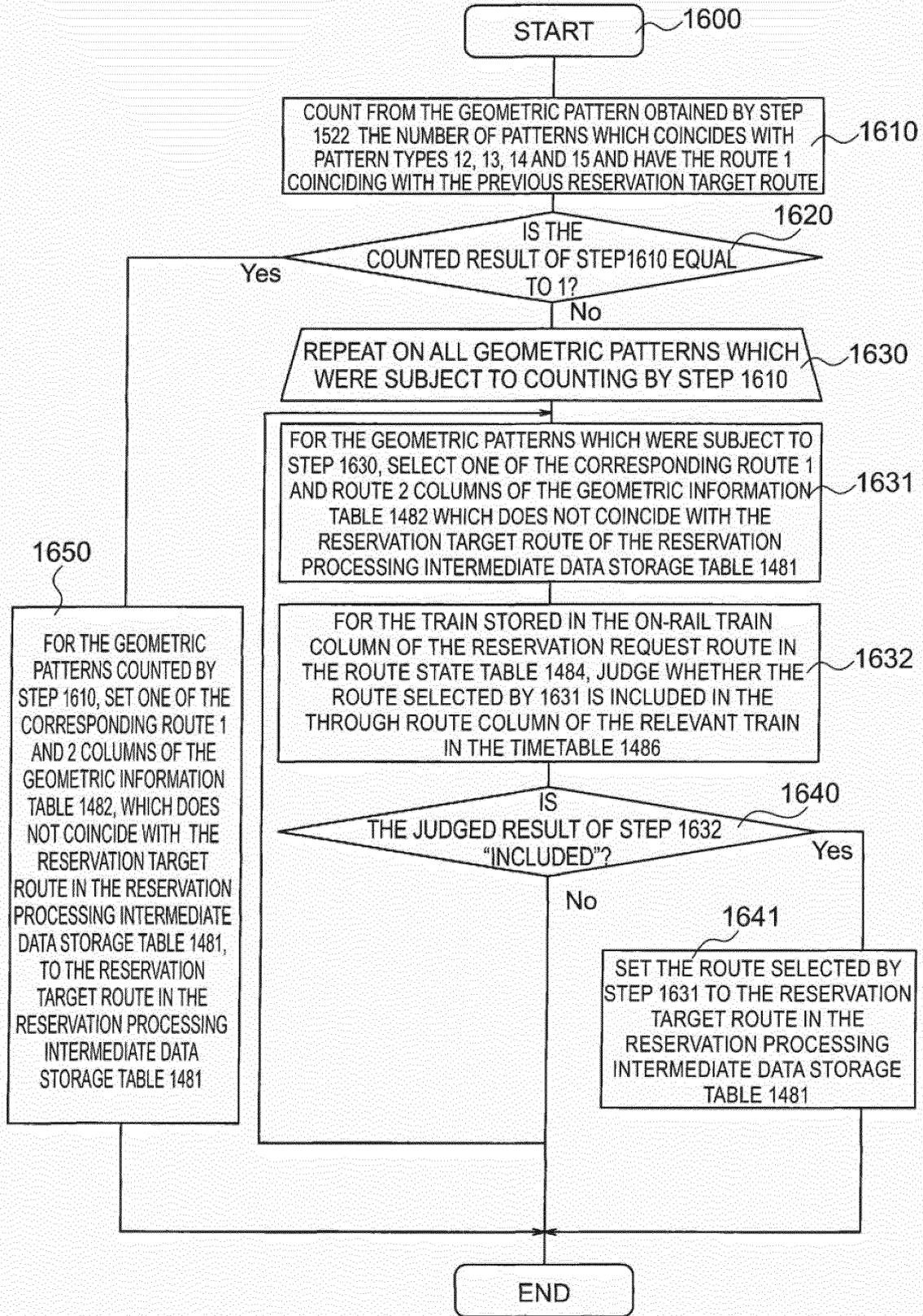


FIG. 17

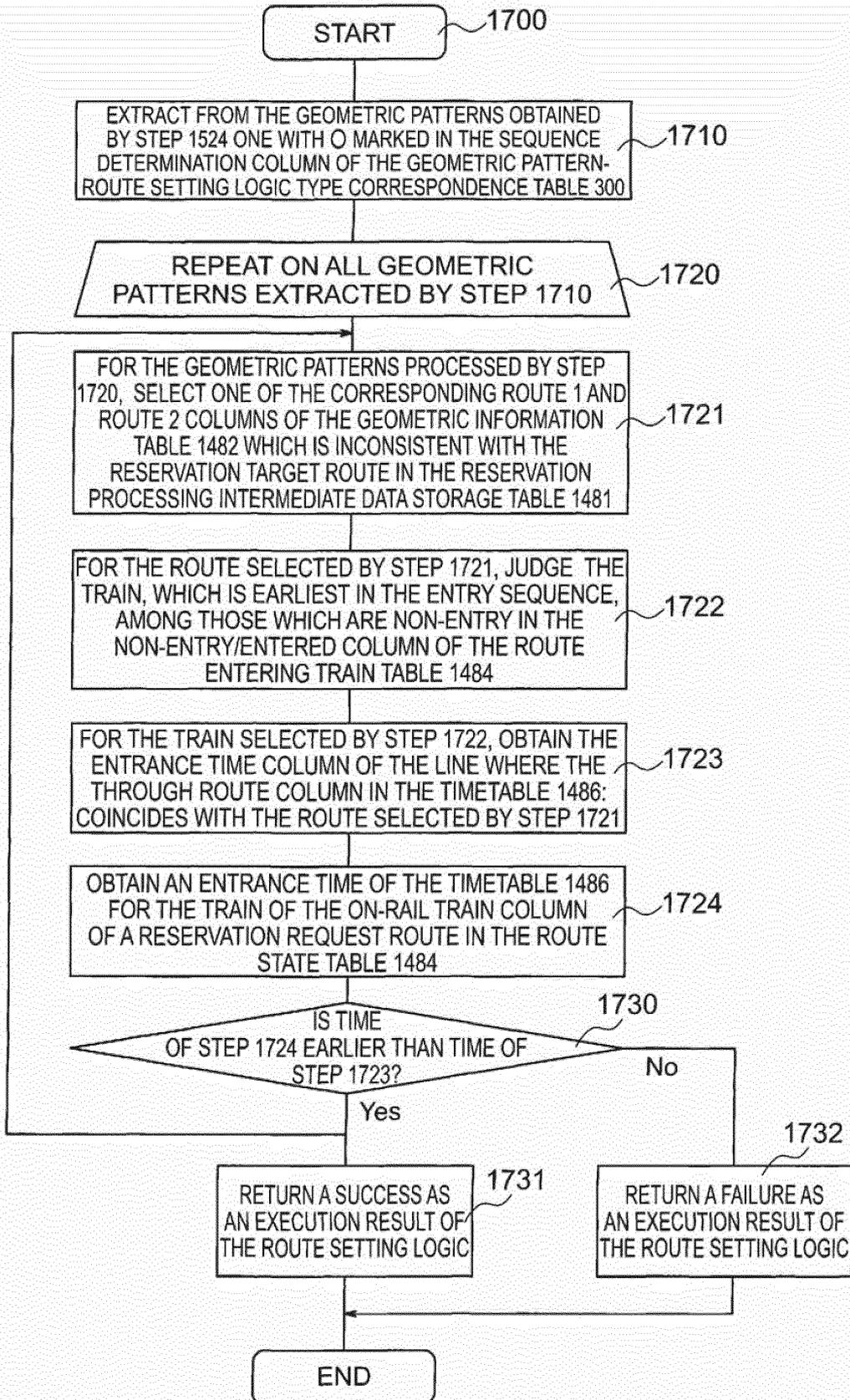


FIG. 18

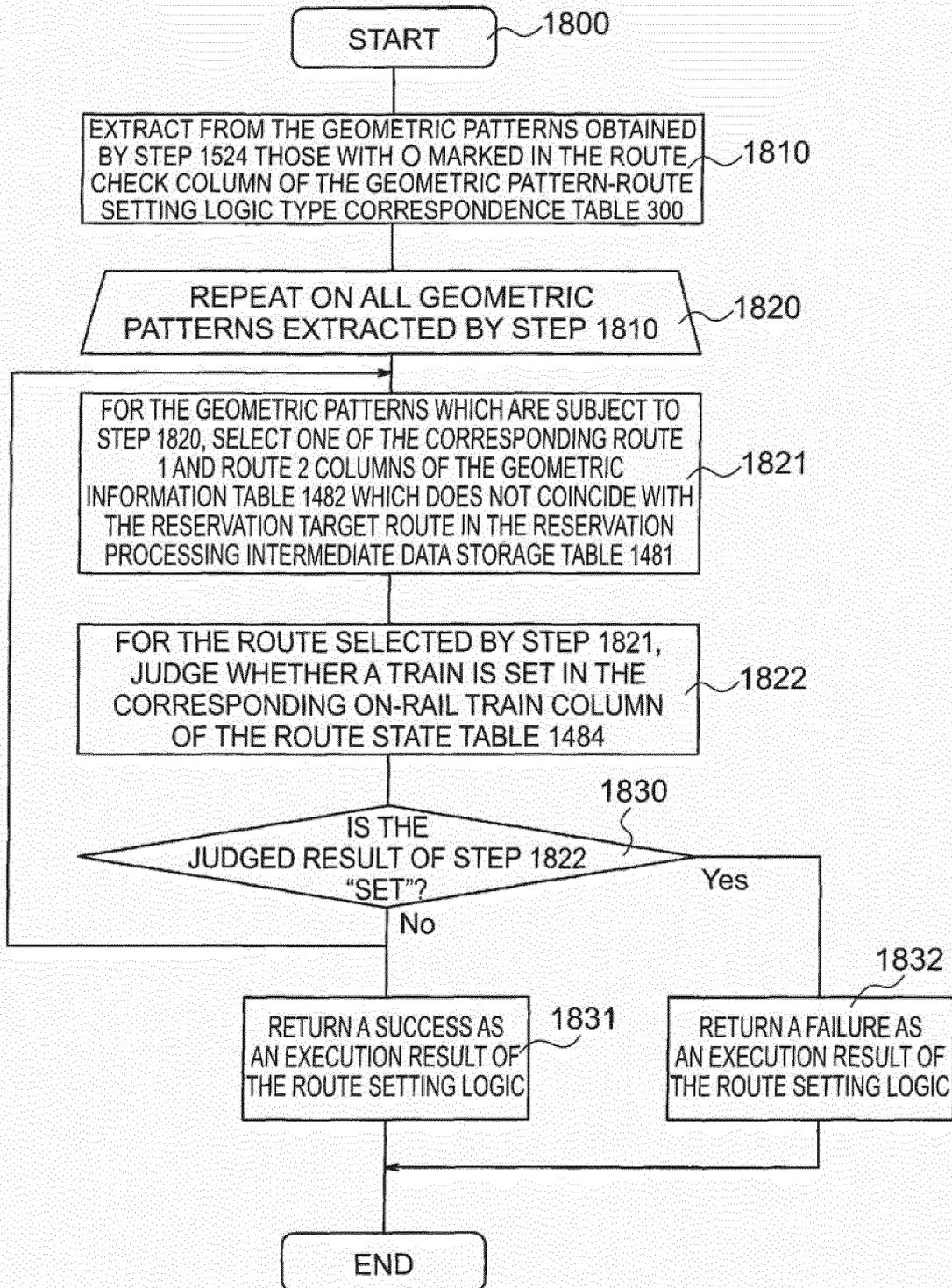


FIG. 19

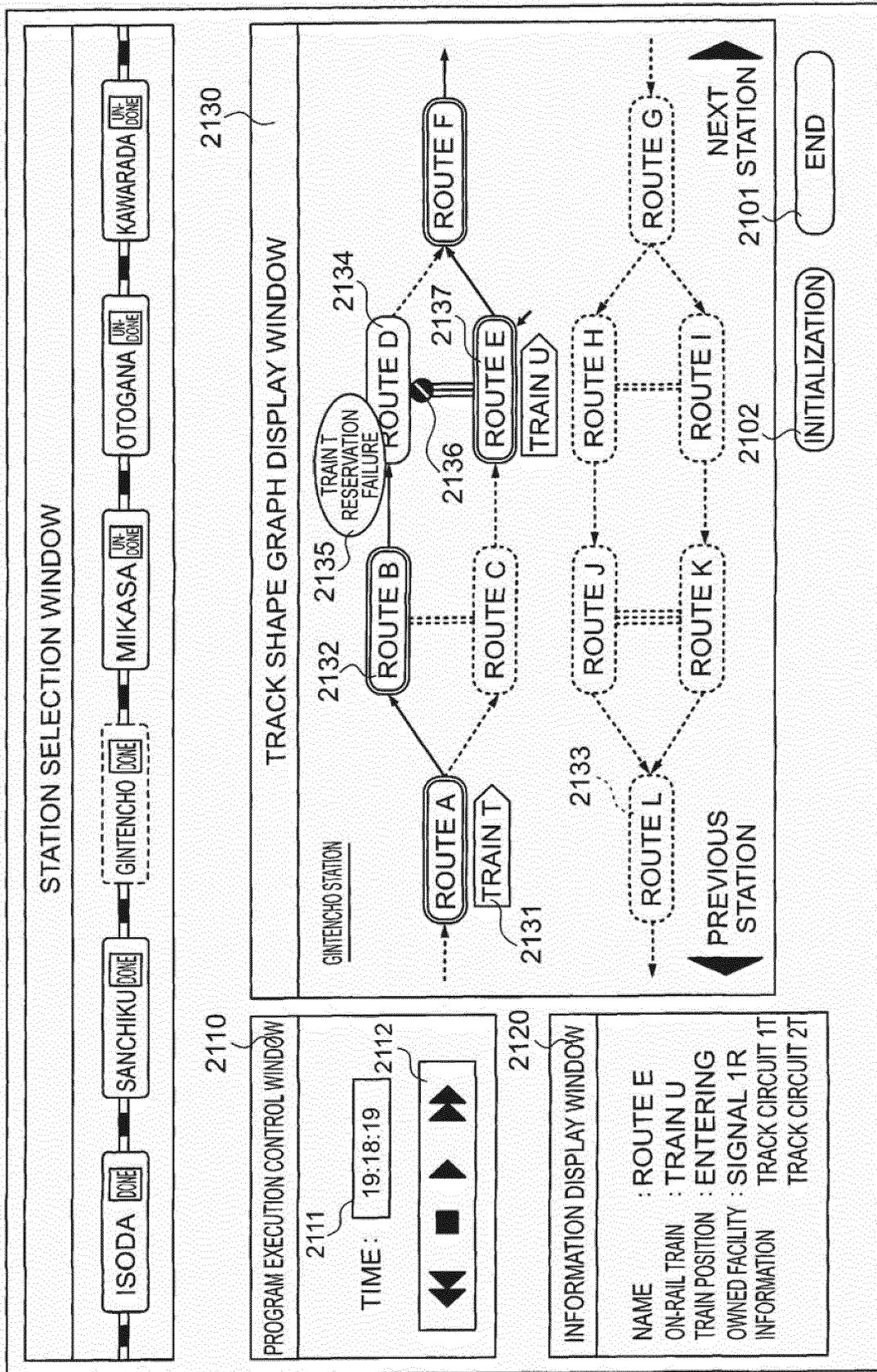


FIG. 20

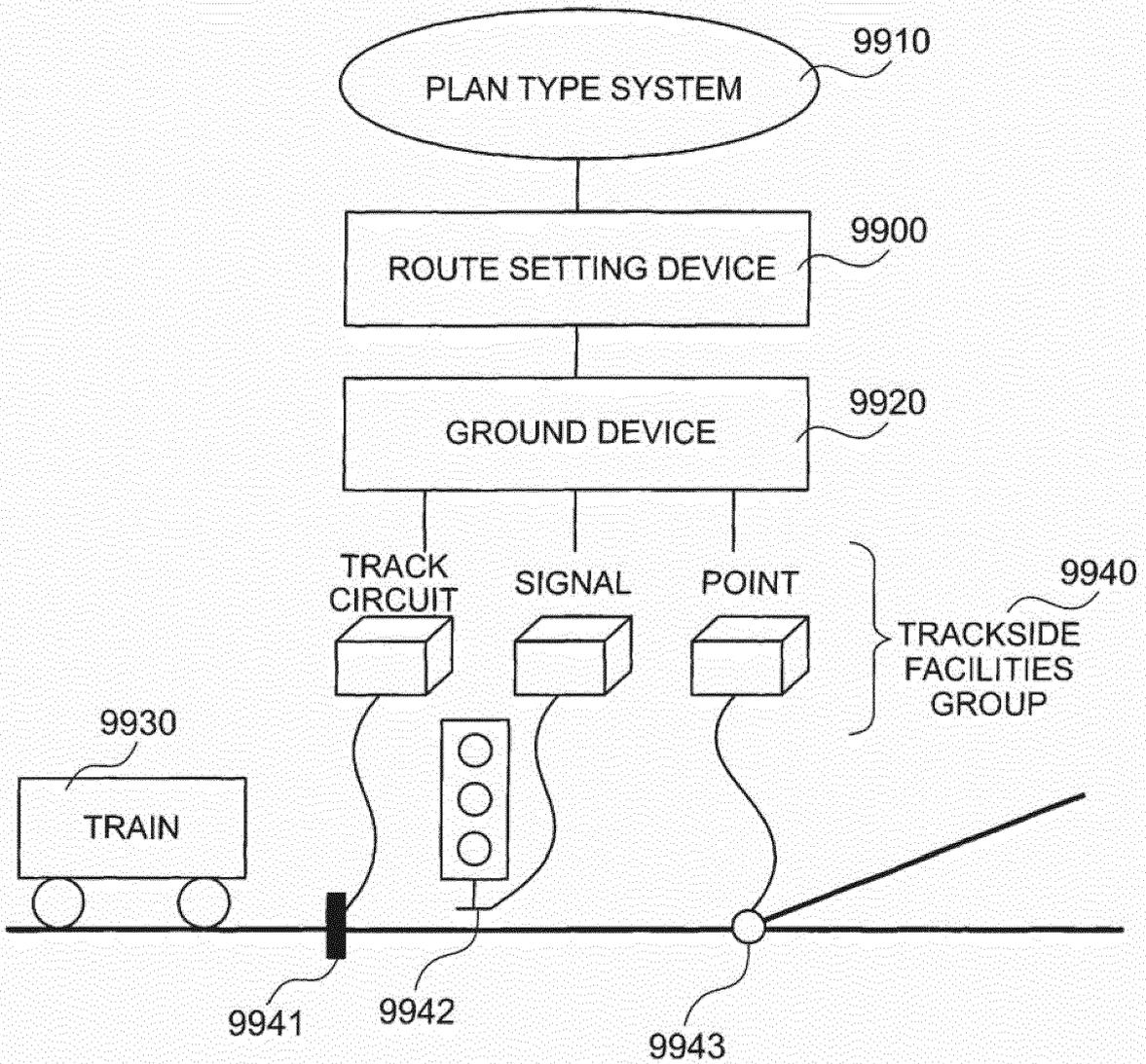
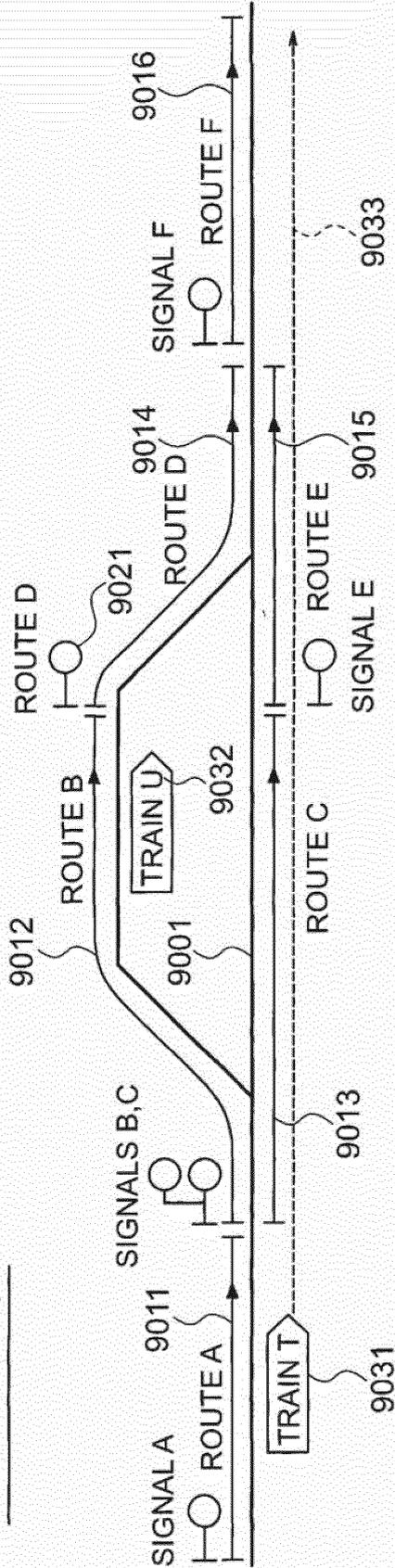
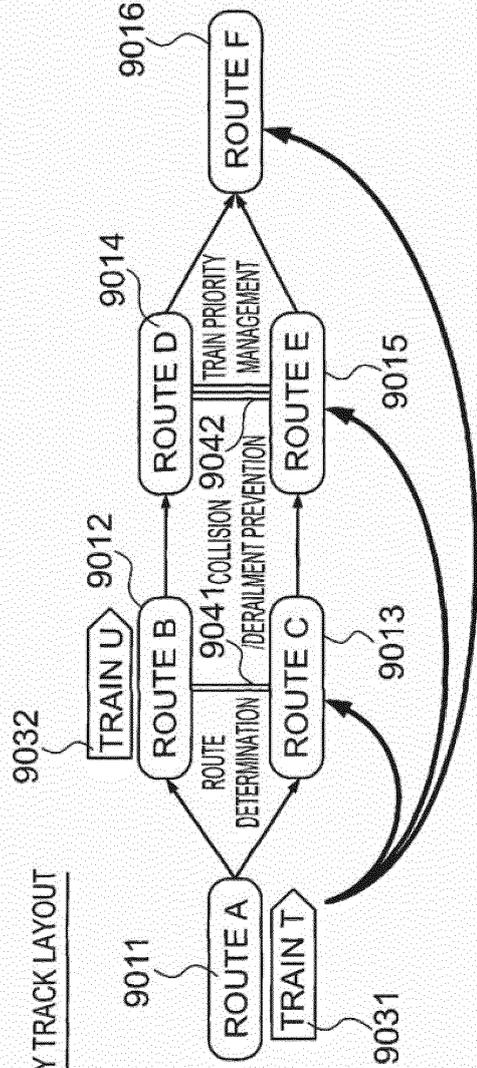


FIG. 21

RAILWAY TRACK LAYOUT



GRAPH DISPLAY RAILWAY TRACK LAYOUT



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/061568

A. CLASSIFICATION OF SUBJECT MATTER B61L19/06(2006.01)i, 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) B61L19/06, B61L27/00		
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 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012		
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.
A	JP 2011-65274 A (Hitachi, Ltd.), 31 March 2011 (31.03.2011), entire text; all drawings (Family: none)	1-8
A	JP 2010-228576 A (Daido Signal Co., Ltd.), 14 October 2010 (14.10.2010), entire text; all drawings (Family: none)	1-8
A	JP 2003-11822 A (Kyosan Electric Mfg. Co., Ltd.), 15 January 2003 (15.01.2003), entire text; all drawings (Family: none)	1-8
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> 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 03 August, 2012 (03.08.12)	Date of mailing of the international search report 14 August, 2012 (14.08.12)	
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	
Facsimile No.	Telephone No.	

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/061568

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 2003-95099 A (Mitsubishi Electric Corp.), 03 April 2003 (03.04.2003), entire text; all drawings (Family: none)	1-8

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011164928 A [0001]
- JP 6321107 A [0005]