turnout device 12 coincide with each other. In addition, the on-board device 11 causes the turnout direction of the train 1 in the turnout section and the turnout direction of the on-board turnout device 12 to coincide with each other, when determining whether or not the train 1 has the approaching right to the section in a case where the wayside device 2 receives a request of the train 1 for the approaching right to the section from the operation management device 3, when the wayside device 2 receives the request of the train 1, and when the section relating to the request is the turnout section and the on-board turnout device 12 is not locked. That is, in a case where the wayside device 2 receives the request of the train 1, when the on-board turnout device 12 is not locked, the on-board device 11 controls the on-board turnout device 12 so that the turnout direction of the train 1 in the turnout section and the turnout direction of the on-board turnout device 12 coincide with each other. In addition, for example, the on-board device 11 recognizes a self-position by passage information and speed integration of a position marker installed on the track, and transmits the self-position to the wayside device 2. In addition, an emergency brake speed pattern is generated, based on a range of the section having the approaching right which is received from the wayside device 2, and in a case where a

train speed exceeds the speed, brake control is performed. The emergency brake speed pattern is a speed pattern that enables the train 1 to safely stop before accessing the section which the on-board device 11 cannot access. The on-board device 11 sequentially receives information indicating the permutation of at least the section having the approaching right from the wayside device 2, and sequentially notifies the wayside device 2 of information indicating at least a current position.

[0020]

In addition, for example, the on-board turnout device 12 can adopt the on-board turnout device disclosed in Patent Documents 1 to 3. The on-board turnout device 12 changes a switching direction (turnout direction) in a normal position state or an opposite position state before reaching the turnout point on the track, in accordance with an instruction of the on-board device 11. Fig. 22 schematically illustrates an example of a track 300 used as an example of the present embodiment, and Fig. 23 schematically illustrates a configuration example of the on-board turnout device 12. The track 300 illustrated in Fig. 22 is configured so that a section name (section identification information) is divided into eight sections (also referred to as sections 1T to 8T) of 1T to 8T. In the track 300 illustrated in Fig. 22, the section 3T is a

section having a turnout point 3t (turnout section), and the section 7T is a section having a turnout point 7t. In this case, the section 3T is divided into a common portion 3Tc of the section 3T, a normal position side 3Tn of the section 3T, and an opposite position side 3Tr of the section 3T, when the turnout point 3t serves as a turnout point. In addition, the section 7T is divided into a common portion 7Tc of the section 7T, a normal position side 7Tn of the section 7T, and an opposite position side 7Tr of the section 7T, when the turnout point 7t serves as a turnout point. In addition, as illustrated in Fig. 23, for example, the turnout point 7t of the section 7T has turnout guide walls 301 and 302. For example, the on-board turnout device 12 has guide wheels 121 and 122 supported by a support shaft 123, moves the support shaft 123 in a rightward-leftward direction indicated by a white arrow, and brings either the guide wheels 121 or 122 into contact with either the turnout guide walls 301 and 302, thereby changing the turnout direction. A state where the support shaft 123 is locked by being moved to the left side or the right side will be referred to as a state where the on-board turnout device 12 is locked.

[0021]

Next, an operation example of the wayside device 2 and the on-board device 11 which are illustrated in Fig. 1 will

the train 1 currently travels in the section. In a case where the train 1 completely passes through the section, the on-board device 11 makes state transition from the passage in progress (ST26) to the unapproachable (ST21).

[0023]

Fig. 3 is a view for describing an example of an information communication direction and information content between the wayside device 2 and the on-board device 11 which are illustrated in Fig. 1. As illustrated in Fig. 3, the wayside device 2 transmits information indicating the permutation of the sections having the approaching right toward the on-board device 11, and the on-board device 11 transmits information indicating a current position of the train 1 to the wayside device 2.

[0024]

Fig. 4 is a schematic view illustrating a configuration example of a right section table 111 managed by the on-board device 11 illustrated in Fig. 1. The right section table 111 illustrated in Fig. 4 is a file that stores all of the sections determined by the wayside device 2 that the train 1 has the approaching right to the sections, in the order corresponding to the traveling direction of the train 1, in association with section names, contents of the turnout, whether or not the train 1 is present on the railway, and whether the sections are approachable by the

approaching of other trains until the train completely passes through the turnout.

[0047]

As described above, according to the first embodiment, the wayside device 2 manages whether each train 1 has the approaching right to each section, and the on-board device 11 determines for itself whether the section including the turnout having the approaching right is approachable. Therefore, the safety can be further improved in the train control system 10 using the on-board turnout device 12.

[0048]

[Second Embodiment]

Next, a second embodiment of the present disclosure will be described with reference to Figs. 16 to 21D. In the second embodiment, a train interval is shortened as follows, compared to the first embodiment. A basic configuration of the train control system 10 illustrated in Fig. 1 according to the first embodiment is common to that according to the second embodiment. In the second embodiment, in addition to the configuration of the first embodiment, the section of the “requested” is also transmitted from the wayside device 2 to the on-board device 11. In addition, the on-board device 11 switches the on-board turnout for the section of the "requested" when the turnout is not locked.

[0051]

Fig. 17 is a view for describing an example of a communication direction of information and content of the information between the wayside device 2 and the on-board device 11 which are illustrated in Fig. 1 according to the second embodiment. As illustrated in Fig. 17, the wayside device 2 transmits information indicating the permutation of the sections having the approaching right and information indicating a requested state of the subsequent section to the on-board device 11, and the on-board device 11 transmits information indicating a current position of the train 1 to the wayside device 2.

[0052]

Fig. 18 is a schematic view illustrating a configuration example of a right section table 111b managed by the on-board device 11 illustrated in Fig. 1 according to the second embodiment. The right section table 111b illustrated in Fig. 18 is a file that stores all of the sections determined by the wayside device 2 that the train 1 has the approaching right to the sections, in the order corresponding to the traveling direction of the train 1, in association with section names, contents of the turnout, whether or not the train 1 is present on the railway, whether the sections are approachable by the train 1, and whether the section is requested.

Claims

[Claim 1]

A train control system comprising:

a wayside device performing exclusive control between trains in each of a plurality of sections that divide a track, and managing whether or not each of the trains has an approaching right to each of the sections; and

an on-board device mounted on the train including an on-board turnout device, and determining for itself that a turnout section is approachable, in a case where the section determined by the wayside device to which the train has the approaching right is the turnout section which is the section including a turnout, when a turnout direction of the train in the turnout section and a turnout direction of the on-board turnout device coincide with each other.

[Claim 2]

The train control system according to Claim 1,

wherein the wayside device determines whether or not the train has the approaching right to the section when a request for the approaching right of the train to the section is received from a higher-level device, and

in a case where the wayside device receives the request with respect to a train, when the section relating to the request is the turnout section and the on-board turnout device is not locked, the on-board device causes a turnout direction of the train and a turnout direction of the on-board turnout device in the turnout section to coincide with each other.

[Claim 3]

The train control system according to Claim 1,

wherein the wayside device sequentially notifies the on-board device of at least a permutation of the sections to which the approaching right is granted, and

the on-board device sequentially notifies the wayside device of at least a current position.

[Claim 4]

An on-board device mounted on trains including an on-board turnout device,

wherein for a section determined by a wayside device to which the train has the approaching right, the wayside device performing exclusive control between the trains in each of a plurality of sections that divide a track, and managing whether or not each of the trains has the approaching right to each of the sections, the on-board

device determines for itself that a turnout section is approachable, in a case where the section is the turnout section which is the section including a turnout, when a turnout direction of the train in the turnout section and a turnout direction of the on-board turnout device coincide with each other.

[Claim 5]

A train control method for a train control system including a wayside device performing exclusive control between trains in each of a plurality of sections that divide a track, and an on-board device mounted on the trains including an on-board turnout device, the train control method comprising:

causing the wayside device to manage whether or not each of the trains has an approaching right to each of the sections; and

causing the on-board device to determine for itself that a turnout section is approachable, in a case where the section determined by the wayside device to which the train has the approaching right is the turnout section which is the section including a turnout, when a turnout direction of the train in the turnout section and a turnout direction of the on-board turnout device coincide with each other.

[Claim 6]

The train control system according to Claim 2,

wherein the wayside device sequentially notifies the on-board device of at least a permutation of the sections to which the approaching right is granted, and

the on-board device sequentially notifies the wayside device of at least a current position.