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(54) **A METHOD FOR PROVIDING TRAIN CONTROL DATA VIA A BALISE**

(57) It is the objective of the present invention to provide a method for providing train control data via a Balise which reflects the demand to reduce the number of balises and LEUs needed to operate a railway installation, thereby reducing the amount of wiring without affecting the operation, or affecting it to the minimum possible only.

This objective is achieved according to the present invention by a method for providing train control data via a balise being configured for transmitting the train control data as a train control telegram to an onboard unit of a rail vehicle, comprising the steps of:

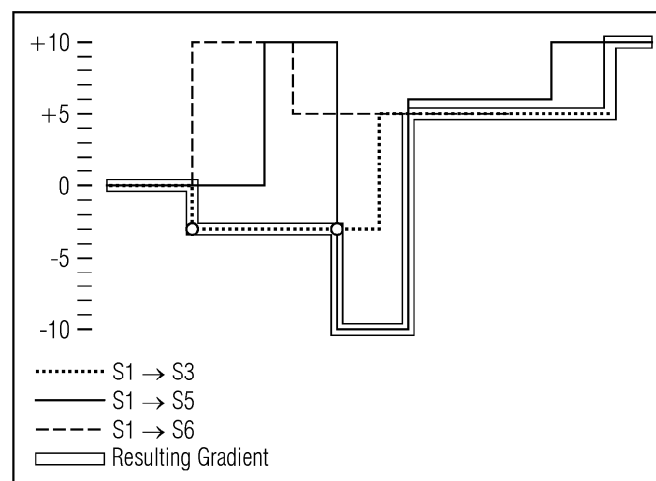
- a) disposing the balise in front of at least one bifurcation of a track section;
- b) determining for the possible train tracks within the track section after the bifurcation a topological profile and/or a speed profile and/or a brake profile;

c) generating an enveloping profile for at least one of the parameter topology, speed and brake, that is applicable for the possible train tracks after the bifurcation, wherein the values of the enveloping profile always consider the most restrictive value in the topological profile and/or the speed profile and/or the brake profile of the possible train tracks;

d) transmitting the enveloping profile once a train approaching the balise has triggered the transmission of the enveloping profile.

Thus, the present method enables solution for the Balise system where only one Balise needs to be placed in front of the bifurcation. As an advantageous further balises and their wiring is made void which over-compensates the drawback that some of the possible train tracks might not receive the most favorable train control data that would have been admissible for these tracks.

FIG 2



Description

[0001] The present invention relates to a method for providing train control data via a balise.

[0002] In order to transmit a train control signal to an onboard unit of a rail vehicle, various equipment is known throughout the world. In many European Countries, the train control data is transferred by Balise systems to the onboard unit.

[0003] In Europe, a large consolidation of the old legacy national train control systems is under way in terms of the European Railway Traffic Management System ERTMS which is currently in the roll-out phase in many European Countries either when new railway lines are built or when existing railway lines are switched from the old legacy systems to the new ERTMS. The ERTMS comprises several key components:

- European Train Control System (ETCS): The in-cab equipment supervises the train movements, including stopping the train, based on maximum permitted speeds at different line sections. It receives track information from ETCS equipment installed beside the track, either Eurobalises or radio signals, to calculate and supervise maximum speeds. The Driver Machine Interface (DMI) displays speed supervision and relevant route conditions to the driver, who confirms changes manually.
- Automatic Train Operation (ATO): The ATO is an ERTMS building block and automates the operation of the train up to Grade of Automation 2 (GoA2). ATO at GoA2 starts and stops the train automatically with ETCS, providing automatic train protection (ATP) functionalities and monitoring train movements and speed limits on the line.
- Railway Mobile Radio (RMR): The RMR facilitates communication between trains and traffic control centres using:
 - GSM-R is based on GSM radio technology and uses exclusive frequency bands.
 - FRMCS is a telecommunication system for railways. It is designed as the successor of GSM-R and is hereby a key enabler for the digitalisation of rail transport.

[0004] The ERTMS therefore aims to replace the different national train control and command systems in Europe. The deployment of ERTMS enables the creation of a seamless European railway system and increases European railway competitiveness.

[0005] Specifically, in ERTMS technology fixed balises and commutable balises are used to transmit the relevant train control information in the form of data telegrams. Fixed balises are not connected to a line-side electronic unit (LEU), thus requiring less wire and wiring. All infor-

mation that can be transmitted by a fixed Balise has to be present in the Balise thus allowing transmissions at low cost and high efficiency.

[0006] To the contrary, commutable balises (transparent balises) require a line-side electronic unit that translates train control commands from the interlocking into data set that enable the transmission of a pre-defined data telegram (out of a variety of projected telegrams). Of course, the LEU requires both the wiring between the interlocking and the Balise which makes the installation of the commutable Balise significantly more expensive as compared to a fix-data Balise.

[0007] For the engineering of the positions of the balises, there exist up to now only two different options:

- a) the ERTMS Track Information is the same in the range for which the balise is providing information to the train. In this scenario, the train control information is packed into fixed balise providing fixed information regardless the specific track.
- b) the ERTMS Track Information is not common over the range for which the balise is providing information. For this scenario, the train control information is packed into commutable balise (variable information depending on the route, e.g. divergences and different tracks from a certain balise that announces information).

[0008] It is therefore the objective of the present invention to provide a method for providing train control data via a Balise which reflects the demand to reduce the number of balises and LEUs needed to operate a railway installation, thereby reducing the amount of wiring without affecting the operation, or affecting it to the minimum possible only.

[0009] These objectives are achieved according to the present invention by a method for providing train control data via a balise being configured for transmitting the train control data as a train control telegram to an onboard unit of a rail vehicle, comprising the steps of:

- a) disposing the balise in front of at least one bifurcation of a track section;
- b) determining for the possible train tracks within the track section after the bifurcation a topological profile and/or a speed profile and/or a brake profile;
- c) generating an enveloping profile for at least one of the parameter topology, speed and brake, that is applicable for the possible train tracks after the bifurcation, wherein the values of the enveloping profile always consider the most restrictive value in the topological profile and/or the speed profile and/or the brake profile of the possible train tracks;
- d) transmitting the enveloping profile once a train approaching the balise has triggered the transmission of the enveloping profile.

[0010] Thus, the present method enables solution for

the Balise system where only one Balise needs to be placed in front of the bifurcation. As an advantageous further balises and their wiring is made void which overcompensates the drawback that some of possible train tracks might not receive the most favorable train control data that would have been admissible for these tracks.

[0011] Advantageously, as the most restrictive value when speed is concerned may be considered the lowest speed for the value in the enveloping speed profile. With other words, the section having the lowest speed value for safety/operation reasons will dominate also the speed in the remaining less restrictive sections by the lowest speed value being transmitted with the enveloping speed profile.

[0012] With respect to the brake profile, the most restrictive value may be considered to be the highest deceleration gradient as long as an enveloping brake profile is concerned. Thus, even less restrictive train tracks may "suffer" from the fact that the most restrictive deceleration value also applies to this or these sections.

[0013] With respect to the topology profile, the most restrictive value can be considered to be the lowest topology gradient as long as an enveloping topology profile is concerned. In other words, the steepest inclination downwards also applies for example for the consideration of the train's brake capabilities even if the track comprises a bigger topology gradient, for example even a positive topology gradient which means that the height of the track increase as seen in the direction of the train which in general would require less brake capability because the increase of the level of the track contributes to the brake capability (the train is braked just by running against the hill).

[0014] Preferred embodiment of the present invention will be explained in more detail hereinafter with reference to attached drawings wherein like numbers designate like objects and which depict in:

Fig. 1 a schematic illustration of a track scenario with a Balise in front of a bifurcation (three possible tracks after bifurcation); and

Fig. 2 a schematic illustration of the possible gradient profiles according to the scenario of Figure 1 and the resulting enveloping gradient profile.

Description of Examples

[0015] Figure 1 schematically shows an illustration of a track scenario with a Balise (triangle and arrow for direction of propulsion) in front of a bifurcation (three possible tracks after bifurcation). The triangle symbol for the Balise represents a fixed-data balise that is sending ERTMS information to a train.

[0016] In case of continuous profiles such as a static speed profile or a gradient profile, the present invention provides for a packaging of the train control information in form of a restrictive envelope to be able to pack gradient

information in fixed-data balise instead of a commutable balise.

[0017] Thanks to this technical measure, the advantages of packing the train control information into a fixed-data balise with the minimum penalty to the operation (this penalty can be adjusted and managed). The minimum iteration can be adjusted as a variable to be considered for the envelope calculation. If an iteration is smaller than the previous commented parameter, then, the iteration can be joined with the most restrictive one from its adjacent and reporting a warning to the user in case both adjacent iterations are not safer than this one just for the technical user.

[0018] Figure 2 schematically shown the values of the gradient profile for the possible different (three) tracks in the scenario of Figure 1. The resulting gradient for these three possible tracks S1 to S3, S1 via S4 to S5 and S1 to S6 is the restrictive optimal envelope for the gradient profile which is packed into the fixed-data Balise thereby eliminating the need to place further balises along the three possible tracks to transmit individual gradient profile for each to the three possible tracks.

[0019] This method according to the present invention manages the train control information that is variable (for different possible paths) in a way that it can be packed in a fixed-data balise instead of a commutable one. Thanks to that, wiring can be saved, LEUs can be saved, and space in balise can be saved and a cost competitive solution is achieved for the company that is implementing ERTMS technology and at the same time affecting at the minimum possible the operations of the train traffic.

Claims

1. A method for providing train control data via a balise being configured for transmitting the train control data as a train control telegram to an onboard unit of a rail vehicle, comprising the steps of:
 - a) disposing the balise in front of at least one bifurcation of a track section;
 - b) determining for the possible train tracks within the track section after the bifurcation a topological profile and/or a speed profile and/or a brake profile;
 - c) generating an enveloping profile for at least one of the parameter topology, speed and brake, that is applicable for the possible train tracks after the bifurcation, wherein the values of the enveloping profile always consider the most restrictive value in the topological profile and/or the speed profile and/or the brake profile of the possible train tracks;
 - d) transmitting the enveloping profile once a train approaching the balise has triggered its transmission.

2. The method according to claim 1, wherein the most restrictive value is considered the lowest speed as long as an enveloping speed profile is concerned.
3. The method according to claim 1 or 2, wherein the most restrictive value is considered to be the highest deceleration gradient as long as an enveloping brake profile is concerned. 5
4. The method according to any of the preceding claims, wherein the most restrictive value is considered to be the lowest topology gradient as long as an enveloping topology profile is concerned. 10
5. The method according to any of the preceding claims, wherein the balise is a fix-data balise. 15

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FIG 1

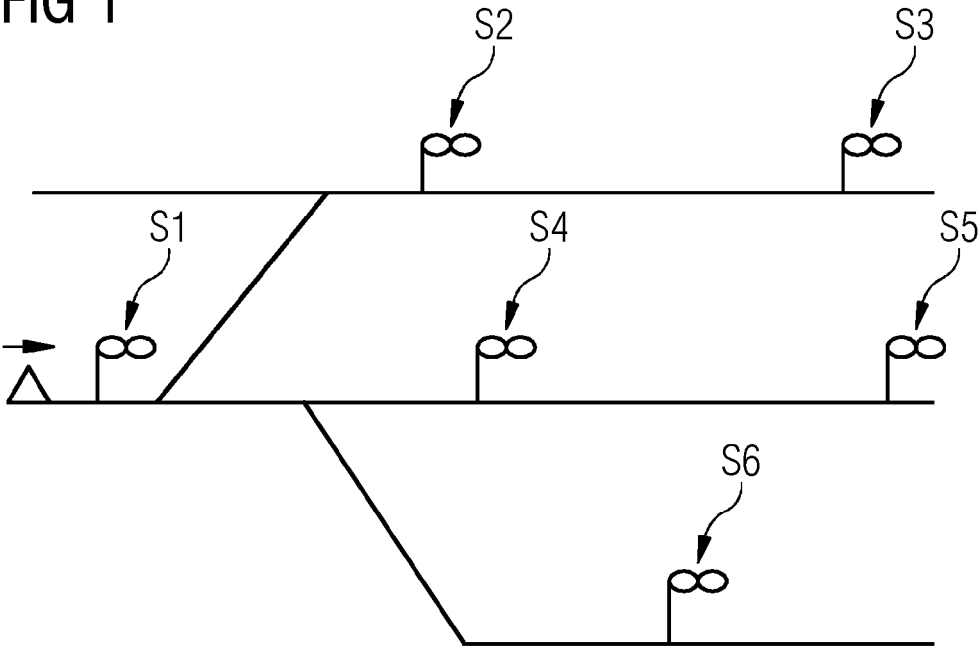
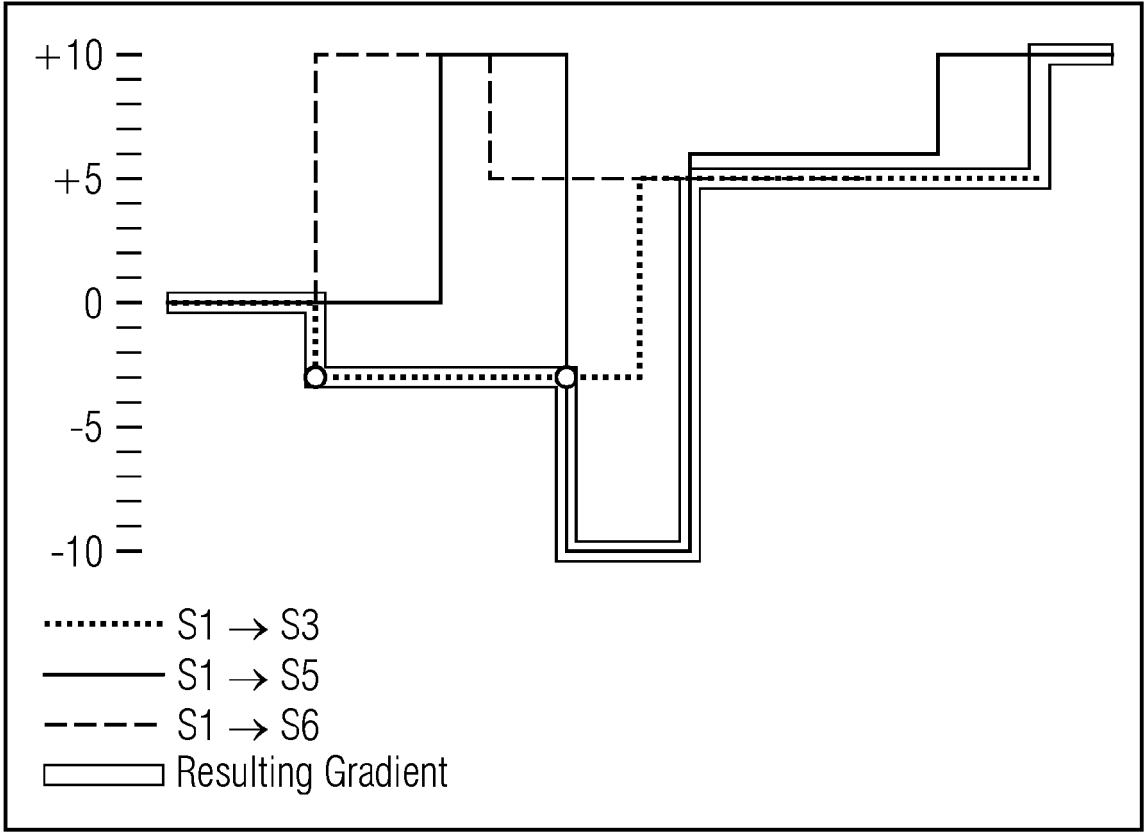


FIG 2





EUROPEAN SEARCH REPORT

Application Number

EP 25 38 2328

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A	US 3 937 432 A (BIRKIN MICHAEL S) 10 February 1976 (1976-02-10) * figures 1 and 2; column 1, line 57 - column 2, lines 67 *	1-5	INV. B61L3/12 B61L27/20
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			B61L
Place of search			Examiner
Munich			Plützer, Stefan
Date of completion of the search			
19 September 2025			
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EP 25 38 2328

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