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(54) **Method, apparatus and computer program product for use with interlocking systems**

(57) It is presented an apparatus comprising: a receiver arranged to receive train position data; a controller arranged to find if there is a matching track circuit input, selected from a plurality of track circuit inputs of an interlocking system, having associated track circuit position

data corresponding to the train position data. The controller is arranged to, when the train position data corresponds to a matching track circuit input, send a signal to the matching track circuit input of the interlocking system. A corresponding method and computer program product are also presented.

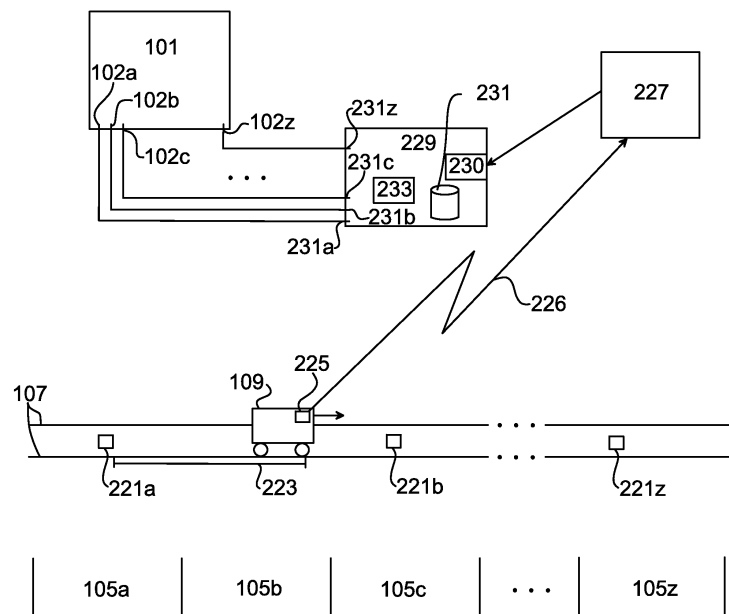


Fig. 2

Description

FIELD OF INVENTION

[0001] The present invention relates generally to interlocking systems and track circuits for train detection, and more particularly to providing an alternative to track circuits for connection to interlocking systems.

BACKGROUND

[0002] Conventional rail way interlocking systems use track circuits or axle counters to detect whether a piece of track is occupied by a train. For example, in the next generation of train control called European Rail Traffic Management System (ERTMS, see <http://www.ertms.com/>) there are several standardised levels according to which signalling systems can operate. In the most advanced mode called level 3, the train itself is responsible for reporting its position and integrity. Hence there is no need for the track circuits/axle counters. However, implementing level 3 is a large undertaking and requires significant effort, risk and cost.

[0003] Consequently, there is a need to more cost-effectively remove track circuits connected to an interlocking system.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to reduce the costs involved with track circuits.

[0005] According to the invention there is provided an apparatus comprising: a receiver arranged to receive train position data; and a controller arranged to find a matching track circuit input, selected from a plurality of track circuit inputs of an interlocking system wherein each of the track circuit inputs have associated track circuit position data, which matching track circuit input has associated track circuit position data matching the train position data. The controller is arranged to send a signal to any matching track circuit input of the interlocking system.

[0006] With such an apparatus, the train position data can be used to derive a corresponding track circuit signal. The interlocking system can thereby remain intact when the track circuits are removed, or not installed for new systems, saving cost and reducing risk of any modifications to the interlocking system.

[0007] The apparatus may further comprise a database comprising track circuit inputs and associated track circuit position data.

[0008] The database can for example be a table allowing a translation from train position to corresponding track circuit input.

[0009] The receiver may be arranged to receive train position data from a central train position receiving device.

[0010] A second aspect of the invention is a method

comprising the steps of: receiving train position data; find a matching track circuit input, selected from a plurality of track circuit inputs of an interlocking system wherein each of the track circuit inputs have associated track circuit position data, which matching track circuit input has associated track circuit position data matching the train position data; and sending a signal to any matching track circuit input of the interlocking system.

[0011] The finding may include performing a look-up in a database comprising track circuit inputs and associated track circuit position data, using the train position data.

[0012] The receiving train position data may include receiving train position data from a position detector of a train.

[0013] The receiving train position data may include receiving the train position data over radio.

[0014] The method may be repeated.

[0015] A third aspect of the invention is a computer program product comprising software instructions that, when executed in a controller, performs the method according to the second aspect.

[0016] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the element, device, component, means, step, etc." are to be interpreted openly as referring to at least one instance of the element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF DRAWINGS

[0017] The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Fig 1 shows a conventional interlocking system with associated track circuits;

Fig 2 shows an arrangement where an embodiment of the present invention is applied; and

Fig 3 is a flow chart showing a method according to the embodiment of Fig 2.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so

that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the description.

[0019] Fig 1 shows a conventional interlocking system with associated track circuits. Track circuit 103a is positioned in section 105a of rail track 107. The track circuit 103a is connected to the two rails of the rail track 107. When a train 109 is present in the section 105a, an electrical connection is provided using the wheels and axles of the train, between the two rails of the track 107. The track circuit 103a can thus detect the presence of the train 109 in section 105a. When the train 109 is detected by the track circuit 103a, a signal is sent to a corresponding input 102a of interlocking system 101, where the input 102a corresponds to the track circuit 103a and section 105a.

[0020] Other track circuits 103b-z corresponding to track sections 105b-z work the same way and have respective corresponding inputs 102b-z of the interlocking system 101. It is to be noted that the track circuits 103a-z can use any suitable detection principle, as long as the train 109 is detected in a corresponding section 105a-z.

[0021] The interlocking system 101 can thus provide appropriate output signals (not shown), such as light signals, commands to rail switches, operator information/warnings/alerts etc. This enables the interlocking system 101 to be part of safe and efficient control of a rail network.

[0022] Fig 2 shows an arrangement where an embodiment of the present invention is applied. Sections 105a-z of rail track 107 are identical to those of Fig 1. Also, the sections 105a-z have respectively corresponding inputs 102a-z of the interlocking system 101, which is identical to the interlocking system 101 of Fig 1. However, there are no track circuits in the arrangement shown in Fig 2.

[0023] A train 209 has an on-board position detector 225. A balise 221a is positioned between the rails of the rail track 107, giving a reference position to the train 209. When the train 209 passes over the balise 221a, the balise 221a sends its identity and/or position data to the train, allowing the position detector 225 to know what balise was just passed. Several balises 221b-z are placed along the rail track 107, and all send their identity and/or position data to any train passing over. It is to be noted that the balises do not need to be aligned with the sections 105a-z. As can be seen in Fig 2, the train 209 is not at an exact position of a balise, but using a tachometer or any equivalent device, the position detector can work out a distance 223 which has been covered since the last passed balise 221a. The position of the train 209 is thus derivable at all parts of the track 107. Other or complementary positioning systems can be used, such as using radio beacons and/or GPS, as long as the position detector 225 can deduce the position of the train 209.

[0024] A central train position receiving device 227, such as a radio block centre 227 as part of a ERTMS system, receives train position data from all trains within

its area. The train position data is sent from the train 209 over a radio interface 226, which for example can be GSM-R (GSM for railways).

[0025] A virtual track circuit apparatus 229 comprises a receiver 230 for receiving train position data 229 from the radio block centre 227 over a wire based or wireless connection. The virtual track circuit apparatus 229 further comprises a controller 233, such as a central processing unit (CPU), digital signal processor (DSP) or any other programmable electronic device, capable of executing a computer program. The virtual track circuit apparatus 229 is connected to the track circuit inputs 102a-z of the interlocking system 101. The track circuit apparatus comprises a database 231 comprising a table of track circuit inputs and associated track circuit position data. The database 231 can be any type of memory capable of holding data allowing a translation to be performed from position data to an associated track circuit input. It is to be noted that the database 231 does not need to be located in the same location as the virtual track circuit apparatus 229; it can equally well be located remotely, as long as the database 231 is accessible to the virtual track circuit apparatus 229. By performing a look-up in the database 231, the virtual track circuit apparatus 229 can determine if the train position data corresponds to any of the track circuit inputs 102a-z of the interlocking system 101. If there is a match, the virtual track circuit apparatus 229 sends a signal to the matching input of the interlocking system 101.

[0026] The signal to one of the matching track circuit inputs 102a-z of the interlocking system 101 is of a format that corresponds to conventionally connected track circuits, such as track circuits 103a-z of Fig 1. For example the signal can conform with an interlocking system like ABB MERKUR, using alternating current (AC) and/or direct current (DC) signalling. Furthermore, for fail safe operation, the track circuit inputs 102a-z can have more than one input corresponding to a section 105a-z. The virtual track circuit apparatus 229 thus sends a signal in appropriate format for the interlocking system 101 to receive.

[0027] It is to be noted that, in this embodiment, the train 209 is responsible for ensuring its own integrity; the train 209 is not allowed to send its position unless it can guarantee that the train is complete.

[0028] Through this arrangement, the need for track circuits is eliminated, while the interlocking system 101 can be kept with minimal or no modification. Consequently, cost, effort and risk is saved. This not only reduces complexity in a conversion from an existing track circuit based system to a train based position detecting system, it can also reduce cost when new systems are deployed.

[0029] Fig 3 is a flow chart showing a method according to the embodiment of Fig 2. References will be made to elements of Figs 1 and 2.

[0030] In an initial receive train position data step 341, train position data is received. The format of the data can for example be an identity of the last balise that was

passed and a distance covered since that balise or longitude and latitude. The train position data is first received in the radio block centre 227 via a radio interface 226 from the train. Optionally, the radio block centre 227 converts the position data from the format received from the train to a format that is suitable for the virtual track circuit apparatus 229. Subsequently, the train position data is received by the virtual track circuit apparatus 229 from the radio block centre 227.

[0031] In a find matching track circuit input step 343, it is determined whether there are any track circuit inputs matching the train position data. It is to be noted that no actual track circuits need to be present for this determination; it is sufficient if there are track circuit inputs such as 102a-z of Fig 1 and 2 of interlocking system 101 with associated track circuit position data. The determination is performed using the database 231 as explained in conjunction with Fig 2.

[0032] In a conditional match step 345, it is determined whether a matching track circuit input was found in the previous step 343. If there was a match, the method proceeds to a send track circuit signal step 347. If there was no match, the method ends.

[0033] In the send track circuit signal step 347, a track circuit signal is sent to the matching track circuit input 102a-z of the interlocking system 101.

[0034] The method can be repeated continuously during the operation of the interlocking system 101 and the radio block centre 227.

[0035] It is to be noted that while the present invention has been illustrated embodied in an ERTMS system, the invention is not restricted to this use. The present invention is applicable in any suitable train traffic control system.

[0036] The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

Claims

1. An apparatus (229) comprising:

a receiver (230) arranged to receive train position data; and

a controller (233) arranged to find a matching track circuit input, selected from a plurality of track circuit inputs (102a-z) of an interlocking system (101) wherein each of said track circuit inputs (102a-z) have associated track circuit position data, which matching track circuit input has associated track circuit position data matching said train position data;

wherein said controller (233) is arranged to send a signal to any matching track circuit input of

said interlocking system (101).

2. The apparatus (229) according to claim 1, further comprising a database (231) comprising track circuit inputs and associated track circuit position data.

3. The apparatus (229) according to claim 1 or 2, wherein said receiver is arranged to receive train position data from a central train position receiving device (227).

4. A method comprising the steps of:

receiving (341) train position data;
find (343) a matching track circuit input, selected from a plurality of track circuit inputs (102a-z) of an interlocking system (101) wherein each of said track circuit inputs (102a-z) have associated track circuit position data, which matching track circuit input has associated track circuit position data matching said train position data; and
sending (347) a signal to any matching track circuit input of said interlocking system (101).

5. The method according to claim 4, wherein said finding includes performing a look-up in a database (231) comprising track circuit inputs and associated track circuit position data, using said train position data.

6. The method according to claim 4 or 5, wherein said receiving train position data includes receiving train position data from a position detector (225) of a train (209).

7. The method according to claim 6, wherein said receiving train position data includes receiving said train position data over radio.

8. The method according to any one of the previous claims, where the method is repeated.

9. A computer program product comprising software instructions that, when executed in a controller, performs the method according to any one of claims 4 to 8.

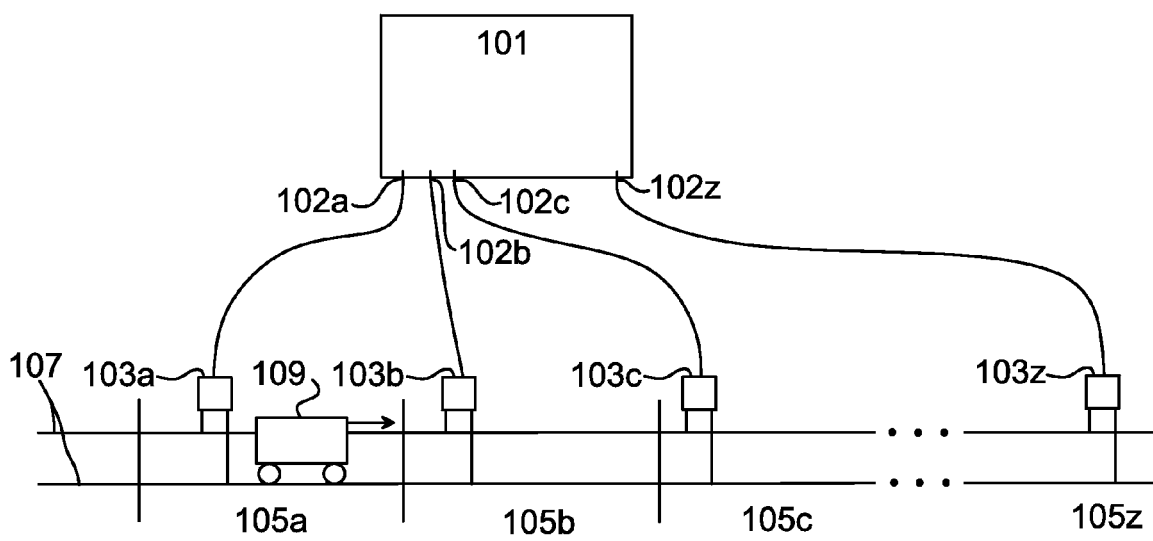


Fig. 1

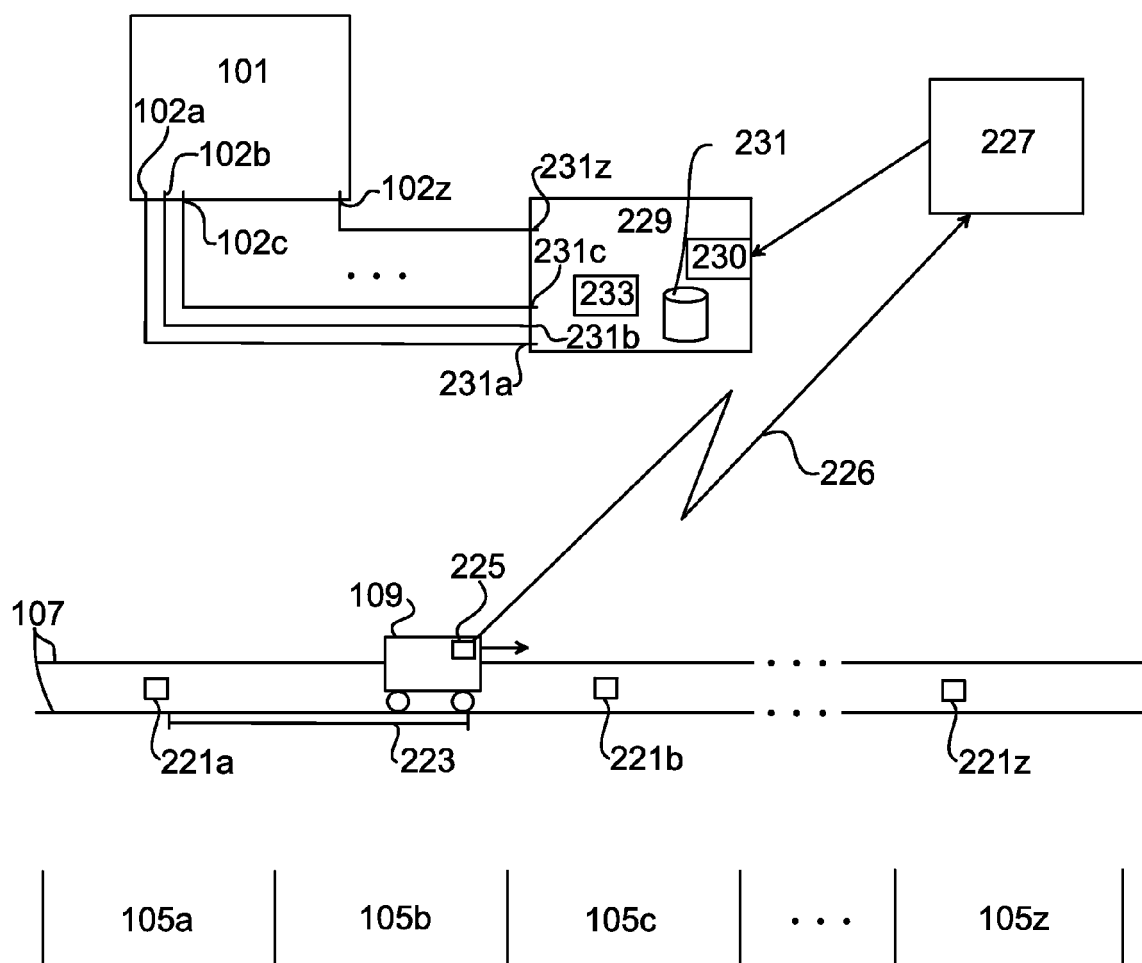


Fig. 2

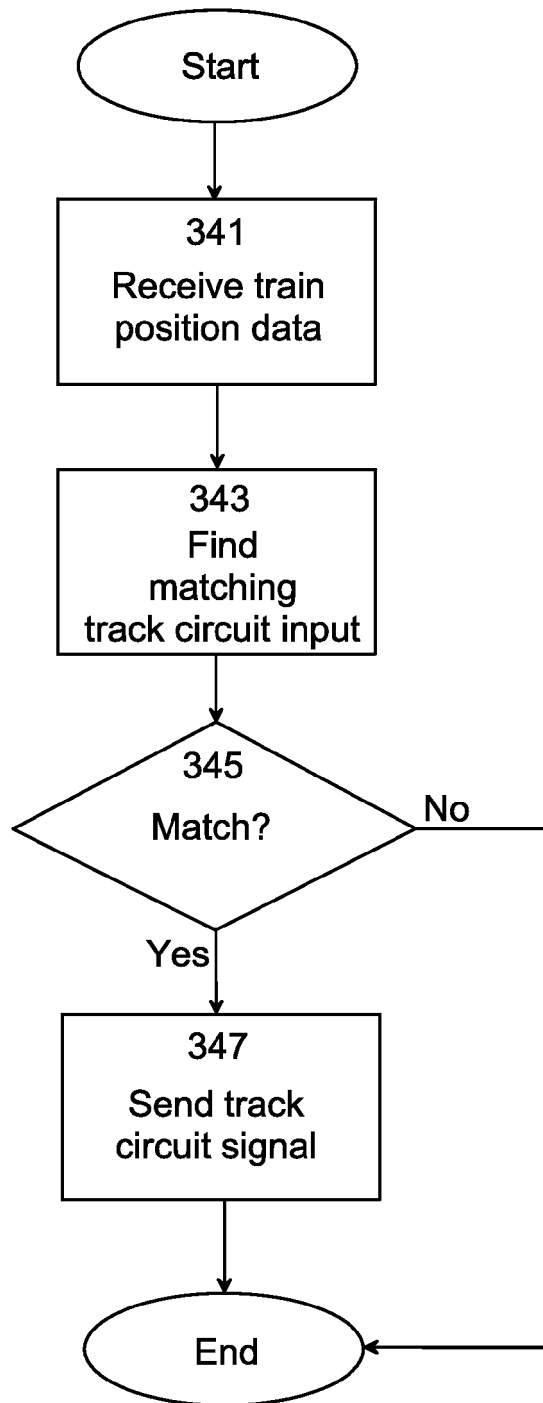


Fig. 3



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Application Number
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Place of search Munich		Date of completion of the search 7 October 2008	Examiner Massalski, Matthias
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EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 7 October 2008	Examiner Massalski, Matthias
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