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(54) Electromagnetic detection system for track vehicles.

(57) An electromagnetic detection system for track vehicles, which detection system comprises at least one transmitter/receiver for generating an electromagnetic interrogation field and at least one responder which, in response to the interrogation field, generates an electromagnetic response signal that can be detected by the transmitter/receiver. The detection system further comprises at least one first connecting element which is fixedly mounted between the rails and which forms an electrical connection between the rails; at least one second connecting element, which is a part of a track vehicle and which in operation forms an electrical connection between the rails. One of the first and second connecting elements is electromagnetically coupled with a responder while the other is electromagnetically coupled with a transmitter/receiver.

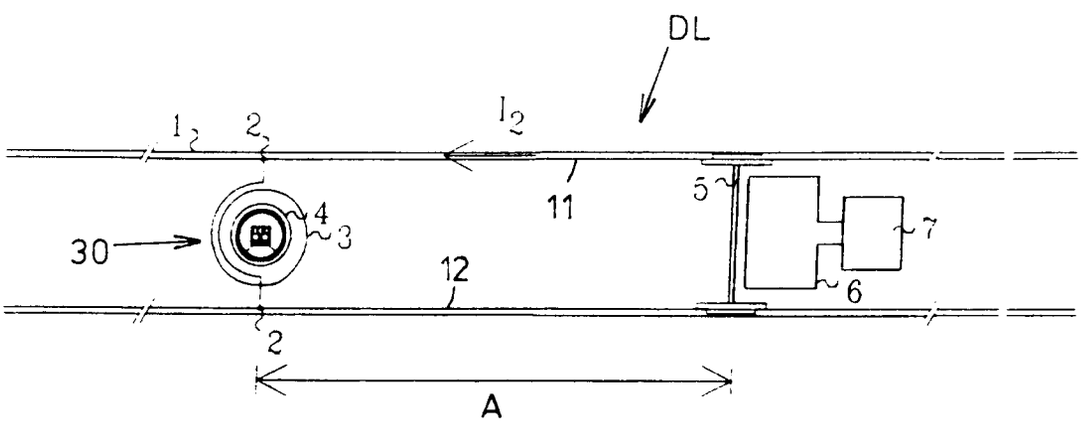

FIG.1

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This invention relates to an electromagnetic detection system for track vehicles, which detection system comprises at least one transmitter/receiver for generating an electromagnetic interrogation field and at least one responder which, in response to the interrogation field, generates an electromagnetic response signal which can be detected by the transmitter/receiver.

In a practical situation, the responder preferably provides a binary coded signal containing a code that is unique for each responder or group of responders, which code can be recognized by the transmitter/receiver.

If the responder is arranged along a railway track and the transmitter/receiver is arranged in a train, the code may for instance comprise information on the location. If the responder is disposed aboard a train and the transmitter/receiver is arranged alongside the railway track, trains that pass the transmitter/receiver can be detected. If coded responders are used, the train can also be identified.

The responders are sometimes referred to as transponders or labels and the transmitter/receivers as reader or interrogator. In principle, it is also possible to use transmitters and receivers designed as separate units

Preferably, use is made of passive responders, i.e. responders which draw the required supply energy from the interrogation field.

Dutch patent no. 176404 describes an electromagnetic identification system and, in particular, a passive coded responder for use in such an identification system.

In principle, such a responder comprises an LC circuit or receiver circuit comprising a coil and a capacitor, and an encoder circuit. When the responder is brought into an electromagnetic interrogation field generated by a transmitter/receiver, the encoder circuit can be supplied via the LC circuit and, further, the code generated by the encoder circuit can be transferred via the same LC circuit. The coupling between the reader and the responder occurs by means of magnetic induction, i.e. that both the electronic reader and the responder comprise a coil with an extensive external magnetic field, so that a magnetic coupling between the coils still occurs if the coils are spaced apart a substantial distance, for instance about 1 m. The time normally required to effect this recognition is about 250 ms.

GB-A-2207837 describes a similar detection system, especially designed for exchanging coded signals between an interrogator mounted in a train and one or more passive coded responders arranged along the railway track.

A drawback of the known systems is that they do not very well enable detection of responders which are arranged at a relatively great distance from a transmitter/receiver or move at a high speed relatively to the transmitter/receiver. This drawback is encountered in particular in the identification or location of vehicles that move over tracks.

The object of the invention is to remove the above-mentioned drawback and more generally to provide an effective detection system for use in track vehicles. To that end, an electromagnetic detection system of the type described hereinabove is characterized, according to the invention, in that the detection system further comprises at least one first connecting element which is fixedly mounted between the rails and which forms an electrical connection between the rails; that the detection system comprises at least one second connecting element, which is part of a track vehicle and which in operation forms an electrical connection between the rails; one of the first and second connecting elements being electromagnetically coupled with a responder and the other of the first and second connecting elements being electromagnetically coupled with a transmitter/receiver.

A method for electromagnetically detecting track vehicles or the location of a track vehicle on a rail track is characterized, according to the invention, in that between the rails of the rail track at least one connecting element is arranged, which forms an electrical connection between the rails; that a responder and/or a transmitter/receiver of an electromagnetic detection system is coupled with the at least one connecting element; that at least one part of a track vehicle is selected which in operation forms an electrical connection between the rails of a rail track; and that a transmitter/receiver and/or a responder is electromagnetically coupled with this at least one part.

In the practice of the invention, the responders and the transmitter/receivers are electromagnetically coupled with each other already at a relatively great distance owing to a detection loop being formed. This loop can, if track vehicles are involved, be formed advantageously by a system of rails, an axle of the track vehicle and a connection provided between the rails. If a transmitter/receiver arranged in the vehicle induces a current in this induction loop by means of the axle of the vehicle, the loop functions as an antenna for the transmitter/receiver. A responder which is disposed in this induction loop. is thereby coupled with the transmitter/receiver arranged in the vehicle. In order to optimize this coupling, the connection between the rails is preferably designed as a winding within which the responder to be interrogated is arranged. In this way, the field that is generated as a result of the current flowing in the induction loop. is optimally coupled with the responder. In this way, a responder can already be detected at a

distance of about 100 m. Starting from a conventional recognition time of about 250 ms, this means that, theoretically, a responder can still be recognized at a maximum speed of 400 m/s. It is observed that the same applies if the above arrangement is reversed, with the transmitter/receiver being replaced by a responder and the responder by a transmitter/receiver. That creates the possibility of identifying individual vehicles.

Hereinafter, the invention will be further described, by way of example, with reference to the accompanying drawings of one embodiment.

In the drawings:

Fig. 1 is a schematic diagram of the above-mentioned detection loop;

Fig. 2 is a schematic view of a responder arranged between the rail tracks;

Fig. 3 is a schematic view of a transmitter/receiver of a system according to the invention, mounted in a track vehicle.

Fig. 1 shows a detection loop DL, comprising sections 11, 12 of rails 1, an axle 5 of a track vehicle, and a galvanic connecting element 3 between the rails 1. By means of an induction loop 6, a current is induced in the axle 5 by a transmitter/receiver arranged, in this example, in a track vehicle of which only an axle 5 with wheels is shown. As a result, a current I_2 arises in the detection loop DL. The current I_2 also flows through the connecting element 3 which is galvanically secured to the rails 1 at points 2. The current I_2 generates an electromagnetic field which is induced in the responder 4. In this way, the interrogation signal of the electronic reader 7 reaches the responder 4 and, in opposite direction, the information signal is transferred from the responder 4 to the reader 7. In this way, a detection distance of about 100 m can be realized. The connecting element 3 preferably comprises a portion 30 comprising one or more windings which are disposed around the responder, as can be seen in Fig. 1. In priciple, another part of the track vehicle can perform the function of the axle 5, provided this part connects the rails electrically in operation.

If a plurality of responders are disposed in a rail track, spaced apart so that the interval exceeds the detection distance, for instance the position of the vehicle can be determined, that is, if the information stored in the responders makes this possible.

Fig. 2 schematically shows a responder 4 comprising a coil 8 and an electronic encoder circuit 9. Via an LC circuit of which the coil 8 is a part, the encoder circuit 9 is provided with energy.

Fig. 3 schematically shows a detail of Fig. 1. A current I_1 generated by transmitter/receiver 7 in an induction loop 6 arranged adjacent an axle 5 of the vehicle, induces a current I_2 in the axle 5 by means of an electromagnetic field 10. This method renders superfluous the use of sliding contacts, for instance, so that the life of such a system is considerably prolonged. It also renders the signal path more reliable.

Via the wheels of the track vehicle, the axle 5 is galvanically connected to the rails 1, which in turn are electrically interconnected by the connecting element 3 adjacent the responder.

It is observed that for the purpose of identifying track vehicles, for instance, one or more transmitter/receivers can be arranged along a rail track, while the track vehicles each comprise a responder which generates a coded signal in an interrogation field. The antenna or induction loop 6 of the transmitter/receiver is then coupled with the connecting element 3 and the responder is electromagnetically coupled with an axle 5 of the track vehicle or, if so desired, with any other element of the track vehicle, which interconnects the rails galvanically. The coil 8 of the responder could for instance be arranged in whole or in part about the axle 5.

It is observed that both above-described types of systems can be used in combination, if so desired. A track vehicle may then comprise both a responder and a transmitter/receiver, while between the rails both responders and transmitter/receivers are arranged. However, it may then be necessary to take measures to prevent cross-talk between the two systems. To that end, the systems may for instance be operated at different times and/or at different frequencies.

Claims

1. An electromagnetic detection system for track vehicles, which detection system comprises at least one transmitter/receiver for generating an electromagnetic interrogation field and at least one responder which, in response to the interrogation field, generates an electromagnetic response signal which can be detected by the transmitter/receiver, characterized in that the detection system further comprises at least one first connecting element which is fixedly mounted between the rails and which forms an electrical connection between the rails; that the detection system comprises at least one second connecting element, which is part of a track vehicle and which in operation forms an electrical connection between the rails; one of the first and second connecting elements being electromagnetically coupled with a responder and the other of the first and second connecting elements being electromagnetically coupled with a transmitter/receiver.

2. An electromagnetic detection system according to claim 1, characterized in that the second connecting element comprises an axle of the track vehicle and the associated wheels.

3. An electromagnetic detection system according to claim 1 or 2, characterized in that the first connecting element has a part comprising a number of windings.

4. An electromagnetic detection system according to any one of the preceding claims, characterized in that a number of windings of a coil which is part of a transmitter/receiver or a responder are arranged around the second connecting element.

5. An electromagnetic detection system according to any one of the preceding claims, characterized in that at least one of the responders is of the type which generates a coded signal in an interrogation field, and that at least one transmitter/receiver is arranged to enable recognition of a coded signal of a responder.

6. A track vehicle comprising a part which in operation connects the rails of a rail track electrically and a responder or transmitter/receiver, electromagnetically coupled to said part, of a detection system according to any one of claims 1-5.

7. A rail track comprising at least one connecting element which connects the rails electrically, with which a responder or transmitter/receiver of a detection system according to any one of claims 1-5 is coupled electromagnetically.

8. A method for electromagnetically detecting track vehicles or the location of a track vehicle on a rail track, characterized in that between the rails of the rail track at least one connecting element is arranged, which forms an electrical connection between the rails; that a responder and/or a transmitter/receiver of an electromagnetic detection system is coupled with the at least one connecting element; that at least one part of a track vehicle is selected which in operation forms an electrical connection between the rails of a rail track; and that a transmitter/receiver and/or a responder is electromagnetically coupled with this at least one part.

9. A method according to claim 8, characterized in that an axle with associated wheels of the track vehicle is selected as said part of a track vehicle.

10. A method according to claim 8 or 9, characterized in that at least one responder is used of the type which provides a binary coded signal and at least one transmitter/receiver which can receive and recognize a binary coded signal.

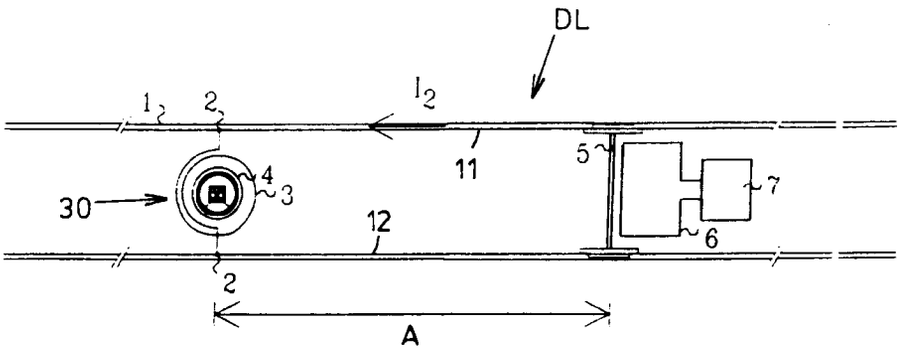

FIG.1

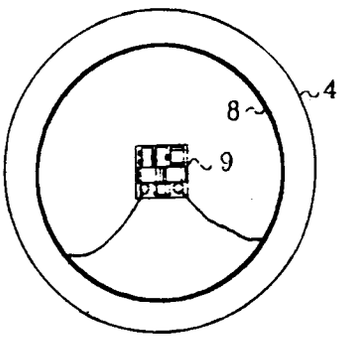

FIG.2

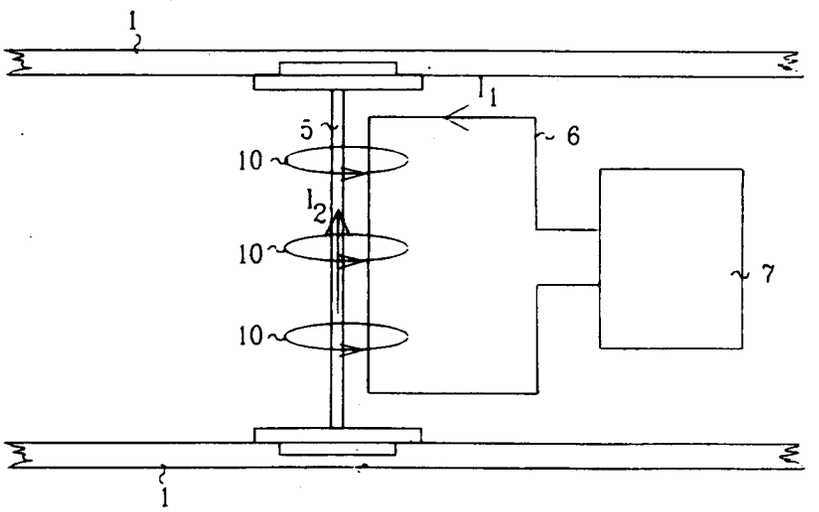

FIG.3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 2287

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A-2 207 837 (BRITISH RAILWAY BOARD) * the whole document * *	1	B 61 L 25/02 B 61 L 25/04
A	WO-A-8 403 264 (JAEGER) * abstract * *	1	
A	US-A-2 910 579 (JONES ET AL.) * the whole document * *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 61 L

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	18 December 91	REEKMANS M.V.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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