

[54] **TRAIN COMMUNICATION SYSTEM**

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[58] Field of Search 246/1 R, 30, 2 S, 2 E, 2 F, 246/187 B, 178; 340/32; 343/6.5 R, 6.5 SS

[56] **References Cited**

UNITED STATES PATENTS

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[57] **ABSTRACT**

This invention relates to a train communication system in which trackside transponder devices containing coded information as to track gradient, speed restrictions etc, pass this information to receiver equipment on the train on receipt of an activating signal from a transmitter on the train. The system is operative to declare a fault if a transponder, at an expected location for said transponder, fails to respond to the activating signal so as to fail to pass information to the receiver equipment.

3 Claims, 3 Drawing Figures

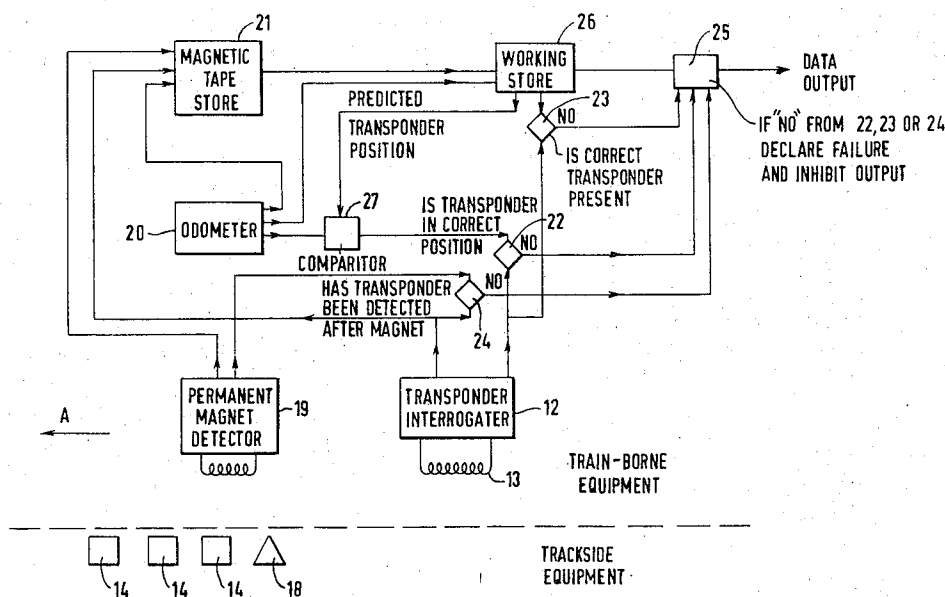


FIG. 1

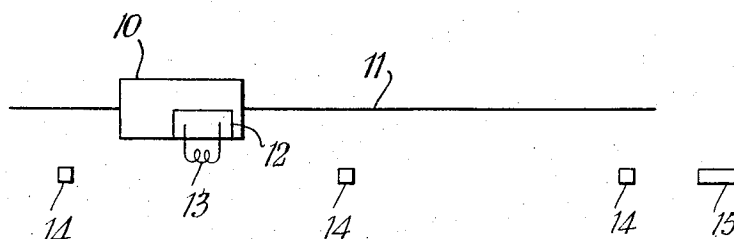
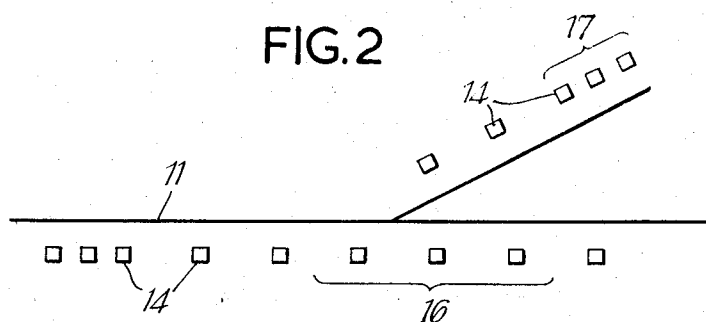


FIG. 2



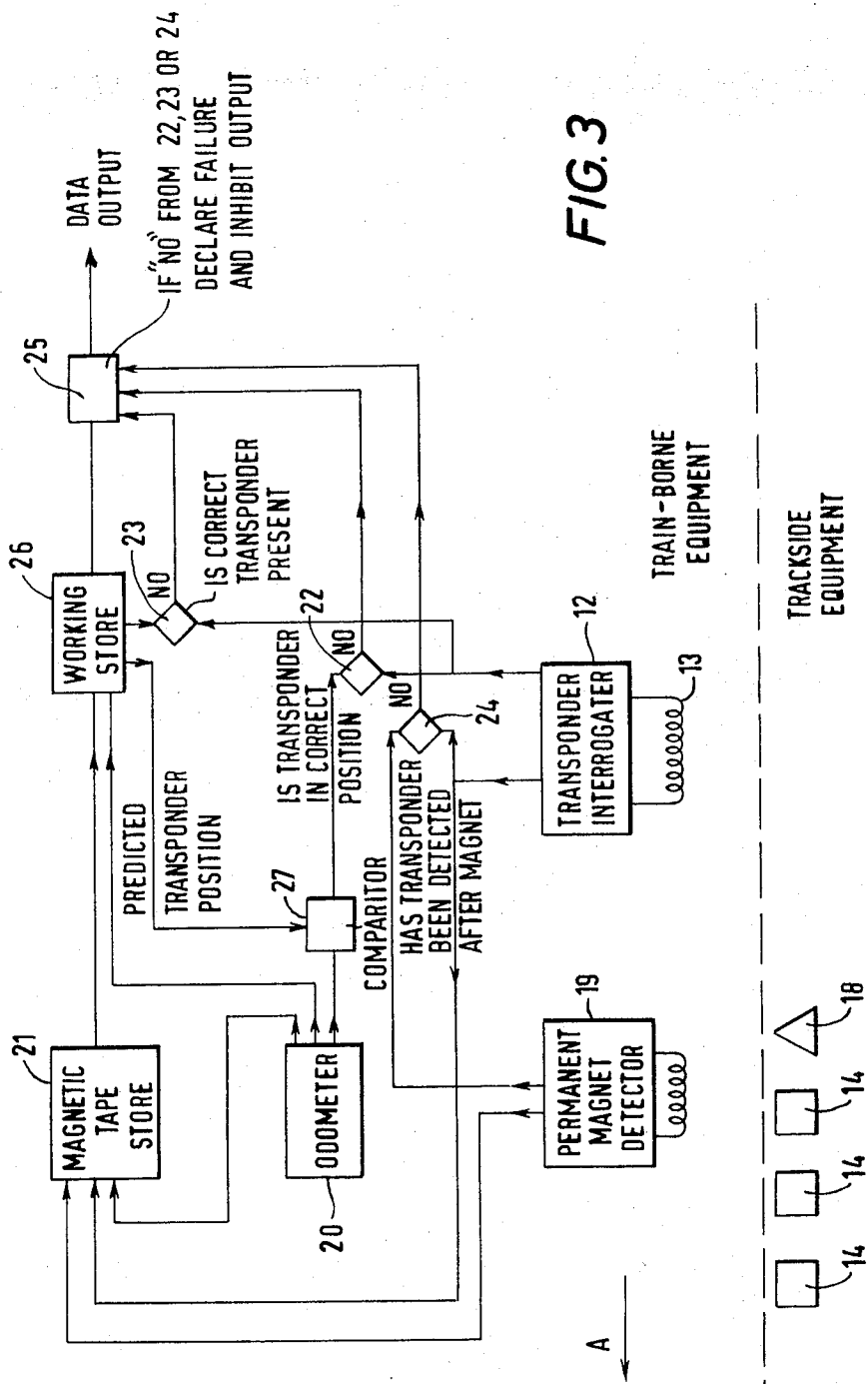


FIG. 3

TRAIN COMMUNICATION SYSTEM

The present invention relates to a train communication system in which information is passed to a moving train from stationary points along the track.

Implementation of train speed supervision requires geographical data, speed limits, gradient and some real-time data such as signal aspect. The fixed data can be programmed onto active or passive devices which are placed in a pre-determined location and which if passive are activated when the train is in the immediate vicinity of the device.

According to the present invention there is provided a train communication system comprising one or more transponder devices adapted to be activated and to transmit data contained therein to a receiver carried on a passing train on reception of an activating signal from a transmitter on said train. The transponder devices are preferably located at intervals determined so as to provide a required resolution to the data. The system is arranged to declare a fault if a transponder, at an expected location for said transponder, fails to respond to the activating signal.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic representation of a train communication system.

FIG. 2 is a representation of a length of railway track including a junction and showing the varying spacing between the passive trackside devices.

FIG. 3 is a block diagrammatic representation of a working embodiment of the present invention.

A train 10 travels along a trackway 11. The train carries an interrogating transmitter/receiver device 12 which has a transmitter/receiver coil arrangement 13. At spaced intervals along the track are positioned passive encoded transponders 14. As the train passes each of these transponders 14, a signal from the transmitter section of the device 12 activates the transponder and causes it to emit a signal containing its encoded information. This signal is picked up by the receiver section of the device 12 and information fed to the appropriate control devices on the train. Such transponder systems are in themselves well known, and the transponder systems employed in the present invention may correspond, for example, to those described in prior British Pat. Nos. 1,068,145 and 1,187,130.

The transponders 14 contain fixed coded information in respect of constant situations such as speed limits, track gradient and other geographical information.

In order to provide a high integrity system it is necessary that any failure of any of the transponders is noted as a fault condition. This can be achieved in a variety of ways of which the following are given by way of example.

Firstly the information encoded within each of the transponders 14 could include the distance to the next of the transponders to be reached by the train. This would enable equipment mounted on the train and which was connected to an odometer to predict the position of the next transponder and hence to declare a fault condition if no transponder responded to interrogation by the transmitter/receiver 12 at that position.

A second way would be to provide a fail-safe trigger point, such as a permanent magnet for example, adjacent to each transponder 14 which would indicate to

train mounted equipment that a transponder 14 had been reached. Failure of a transponder to respond to interrogation by the transmitter/receiver 12 after a triggering signal had been received would indicate a fault condition.

Thirdly the transponders 14 could be positioned at each location in groups of two or three, each programmed to give identical information. This would introduce a measure of redundancy as the chances of more than one transponder failing at the same time is very small.

Fourthly, the train mounted equipment could include a stored program, in the form of a magnetic tape for example, which would predict the position of each transponder. Failure of a transponder to respond at the predicted location would indicate a fault warning. The program would be advanced either continuously by being linked to an odometer, or in steps, the reception of a signal from each transponder causing the program to advance one step to provide information as to the location of the next transponder.

The four examples just described could be used either single or in any combination to provide a high integrity system.

The spacing between adjacent transponders 14 is determined by the required resolution of data to be passed to the train.

In addition to the passive transponders 14, active devices 15 may also be provided at intervals beside the track. These active devices transmit continuously updated real time data to the train on information such as signal aspect.

In an area where shunting manoeuvre may be required, the transponders 14 can be positioned and programmed in such a way that fine control over the shunting vehicle may be achieved.

FIG. 2 shows a junction area, in which 16 and 17 indicate examples at the different spacing used to achieve 'coarse' and 'fine' resolution respectively of the geographical data being passed to the train so as to more accurately control a shunting manoeuvre for example.

FIG. 3 depicts a working embodiment of the present invention in greater detail. If it is assumed that the train is traveling in the direction of the arrow A, a fail-safe triggering device 18, taking the form of a permanent magnet, positioned by the trackside in advance of the transponders 14, is detected by a permanent magnet detector 19 carried by the train. When the permanent magnet 18 is so detected, a signal from the detector 19 is passed as one input to a decision circuit 24 which is operative to check the presence of a transponder after the fail-safe trigger device 18 has been passed. More particularly, further movement of the train past magnet 18 enables the transponder interrogating transmitter/receiver 12 to come into range of the first transponder 14. As soon as a signal is received from a transponder, a signal is sent from the interrogator 12 as a second input to the circuit 24. If no such second signal is received by the circuit 24 within a predetermined time interval, the circuit 24 provides an output to circuit 25 to declare a system failure and inhibit further output of train control data.

On activation of the detector 19, a signal is also sent from said detector 19 to a magnetic tape store 21 to prime the store 21. Information as to the geographical position of each transponder 14 is contained in the store 21. This information is passed to a working store

26, from which it is eventually passed to a decision circuit 22 when the actual position of the train, as determined by its odometer 20, agrees with the predicted position of the transponder. The actual train position and predicted transponder position are compared in a comparator 27, and when the two signals agree a signal is sent from comparator 27 to decision circuit 22. The signal is also sent to the circuit 22 when a transponder is located by the interrogator circuit 12, to prevent a "fault" signal being sent to the circuit 25.

The odometer 20 is also linked to the tape store 21 and to the working store 26 to advance these stores in step with the passage of the train.

The information carried in the transponder 14 is passed to the main store 21 where first-order checks are carried out. The information, together with any information already in the store 21, such as predicted transponder position as described above, is passed to the working store 26 from which it is passed through an appropriate vehicle control system when appropriate.

FIG. 3 includes an additional check as to transponder identity. This additional check is carried out by the circuit 23. The actual identity as determined by a signal from the interrogator 12 is compared with the predicted identity obtained from information contained in the store 21 and, provided the two identities match, no "fault" output is sent to the circuit 25.

Circuit 23 thus operates to check the validity of the transponder. Circuit 24 checks the presence of a transponder after the fail-safe trigger point (or magnet) 18 has been passed. Circuit 25 declares a failure and inhibits train control data output unless all necessary conditions precedent to such control data output have been found to be present. Circuit 26 is a working store into which data is temporarily placed after its extraction from the magnetic tape store 21, and before its validity

has been checked. We claim:

1. A train communication system comprising a track having a train moving thereon, said train carrying a transmitter and a receiver, at least one transponder mounted adjacent the track, said transmitter being operative to transmit an activating signal for activating said transponder when said train passes said transponder, said transponder, when so activated, being operative to transmit data contained therein to the receiver carried on the passing train, a fail-safe triggering device associated with each transponder for transmitting a signal to said train operative to trigger said receiver on said train to render said receiver operative to accept said data from said transponder, and means responsive to the failure of a transponder to respond to the activating signal from said transmitter after reception by said receiver of a signal from said triggering device for declaring a fault, said last-named means including a program device carried by said train to provide information regarding the expected location of each transponder whereby the failure of a transponder at the expected location to respond to the activating signal will result in a fault being declared.

2. The train communication system of claim 1 wherein said system comprises a plurality of said transponders disposed in spaced relation to one another along the track, the spacing between adjacent transponders being such as to provide a required resolution of data.

3. The train communication system of claim 1 wherein said fail-safe triggering device comprises a permanent magnet located adjacent said transponder, and detector means carried by said train responsive to the presence of said permanent magnet.

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