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(71) Applicant: **Siemens PLC.**
Camberley, Surrey GU16 8QD (GB)

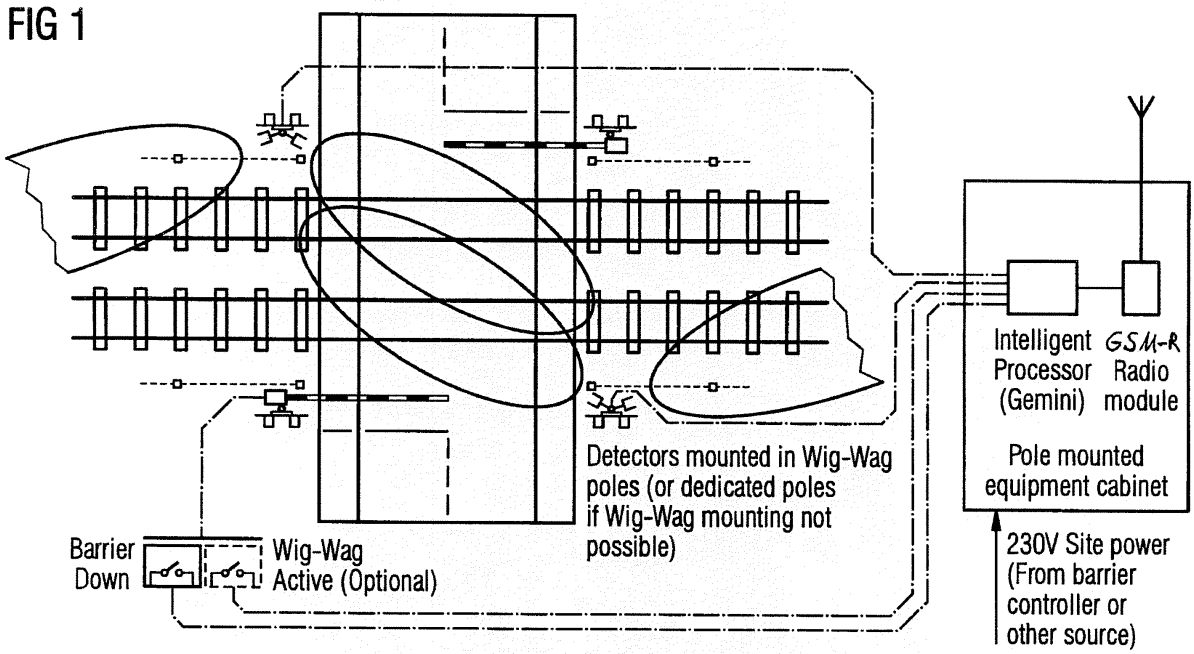
(72) Inventors:
- **Jones, Paul**
  Broadstone, Dorset BH18 9LZ (GB)
- **Manston, Keith**
  Poole, Dorset BH17 7YU (GB)
- **Slesser, Richard**
  Andover, Dorset SP11 8JE (GB)

(74) Representative: **Bruns, Olaf**
Siemens AG
Postfach 22 16 34
80506 München (DE)

(54) Rail crossing protection system

(57) According to the invention, a system is provided comprising at least means for detecting an obstruction on a rail crossing and sending an information to at least one train approaching the crossing, wherein the sending of the information to the train is realised using a radio communication network.

FIG 1



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Description

[0001] A system for detecting major obstructions on un-manned rail crossings and sending information to approaching trains to warn them of such obstructions is disclosed. According to one embodiment of the invention, a GSM-R (Global System for Mobile Communications - Railway) radio communication network is used for sending the information directly to the approaching trains.

[0002] In many instances where the road network intersects the rail network the crossing points are unmanned. These un-manned crossings are usually protected by full barriers or so called Automatic Half Barriers, but in other cases crossings are 'passive', relying on the user to open gates and to check that there are no trains approaching before traversing the rails.

[0003] At all un-manned crossings there is a risk that a vehicle may enter the crossing space when a train is approaching. This may be, for example, because the vehicle drivers chose to ignore warning Wig-Wag signals (where they are provided) or because they are genuinely unable to clear the crossing space, for example because they have broken down.

[0004] As a secondary problem it is possible, when road junctions are in very close proximity to a rail crossing, for vehicles to accidentally turn off the crossing onto the rails. Such vehicles can cause an obstruction to oncoming trains even though the vehicles are not actually on the crossing and may not be detected by conventional crossing protection systems. Existing rail crossing protection systems use several means to detect potential obstructions at the crossing and then interface to the rail signaling system to stop trains approaching the crossing. However, in many cases there are no suitable signals in place that can be activated in time to stop an approaching train. These may be either too far away from the crossing so the train has already passed them at the point that the crossing is identified as obstructed, or they are too close to the crossing so that activating the signal does not provide sufficient time to slow or stop the train.

[0005] It is known in the art to use radio network infrastructure to establish communication between transceivers at a rail crossing and trains. Examples of this are disclosed in W02007/134430 A1, US 5,864,304 or FR 2 784 342.

[0006] The objective of the present invention is therefore to provide a system that allows at least a warning to be issued to an approaching train in such circumstances.

[0007] According to the invention, a system is provided comprising at least means for detecting an obstruction on a rail crossing and for sending an information to at least one train approaching the crossing, wherein the sending of the information to the train is realised using a radio communication network. This has the advantage that such information, for example a warning message sent directly to the train to notify the train driver and/or on-board train control system of a detected obstruction on the rail crossing, is received without further delay which might otherwise be caused by the involvement of other network components and/or rail signalling infrastruture.

[0008] According to one embodiment of the invention, a radio communication protocol based on the GSM-R radio communication standard is used. The GSM-R standard is inter alia defined in ETSI standard EN 301 515 and the technical specification ETSI TS 102 281. According to a further embodiment of the invention, an Emergency Group Call message as defined in the GSM-R standard is used for sending the information.

[0009] According to another embodiment of the invention, radar detectors are used to detect an obstruction on the rail crossing. Such radar based detector is for example the Heimdall traffic detector of Siemens which is already used for detection of road based traffic, see for example the document entitled "Heimdall traffic detector family", available via the following link:

http://www.siemens.co.uk/traffic/pool/documents/brochure/heim dall_2.pdf

[0010] According to another embodiment of the invention, radar detectors are also used to detect trains approaching the rail crossing.

[0011] The present invention is intended to enhance the safety at a variety of different crossing types, specifically at un-manned rail crossings, and thereby provides an additional safety feature.

[0012] Examples of the inventive concepts are further described with reference to the following figures.

FIG 1 shows an overview of an automatic half barrier system,
FIG 2 shows the system of FIG 1 with additional on-track detectors,
FIG 3 shows an overview of a user worked crossing protected by miniature warning lights, and
FIG 4 shows an overview of a user worked single track crossing.

System at Automatic Half Barrier (AHB) crossings

[0013] The system shown in FIG 1 consists of two special radar detectors, for example the above mentioned Heimdall detectors which allow both moving and stationary obstructions to be detected. These detectors each define an on-crossing detection zone and are positioned such that vehicles or other potential obstructions on the crossing, i.e. in the detection zone, are detected. Two further detectors are arranged to detect the approaching trains, so that the system or the radar detectors for the crossing can be disabled as the train passes through the crossing, to prevent unwanted warning messages being sent to the train.

[0014] A processor unit and a GSM-R radio module are located in an equipment cabinet which might is mounted on the pole of the Wig-Wag crossing signal.

Such processor may be a processor used for the so called Gemini platform of Siemens. For further information, please refer to the following link: http://www.siemens.co.uk/traffic/pool/documents/brochure/gemi ni.pdf

[0015] The processor unit is responsible for analysing data from the detectors and the barrier controller as well as for sending an Emergency Group Call according to the GSM-R protocol should an obstruction be detected when the barriers are down. This Emergency Group Call may contain the crossing name or an identifier of the crossing.

[0016] The system is engaged by a confirmation signal from the barrier controller indicating that the barrier is 'down'. Such confirmation may be provided via a volt-free contact, where an open contact indicates barrier down. This is fault tolerant as any loss in cable integrity will automatically engage the system.

[0017] Once the system is engaged, any presence detected by the detectors on the crossing which persists for more than a configurable time, for example set at two seconds, will give rise to an Emergency Group Call via the GSM-R network. For example, a voice call message will be automatically generated by the processor unit and will contain a warning that the crossing may be obstructed, together with the crossing name to ensure that, if more than one train is within group call area in which the Emergency Group Call will be broadcasted, it is clear which train may be at risk of a potential collision with the obstruction on the crossing. For example, two cycles of the warning message will be played, after which the processor unit will release the uplink of the radio communication to the GSM-R communication network. The call will be automatically answered by all train based radio transceivers (also called cab radios) in the group call area. The cab radio in the train will display the emergency call and for example the message "STOP", and the driver will hear the warning announcement. The driver can then stop the train and acknowledge the emergency call which will remove the "STOP" message from the display of the cab radio. The driver can then attempt to speak to the signaller by pressing the PTT (Push-To-Talk) button on the handset, after which the signaller will release the call.

[0018] As the train approaches the crossing, it will be detected by the approach detector which will disable the sending of any warning messages during the trains passage over the crossing and for a configurable time after it has passed the crossing. This time may be typically a few seconds. If the barriers are still down at the end of this configurable period, the system will be re-engaged, as it will be assumed another train is approaching. The approach detectors, specifically the above mentioned Heimdall detectors from Siemens, are typically able to detect trains approaching at speeds between approximately 4 and 120 KPH.

[0019] The system will be disengaged again when the barrier down signal indicates that the barrier is no longer in the down position.

[0020] As part of the processor unit's functionality, a time-stamped log may record the time and date of each barrier down event and each Group Call made for future reference should this be needed.

Further features

[0021] Detector fault Monitoring: The system is dependent on its detectors functioning properly and these may be regularly validated using Detector Fault Monitoring (DFM) principles. For the on-crossing detectors the detection of vehicles normally traversing the crossing can be used to validate the correct operation of the detectors. If detector activation has not been seen for a configured time (i.e. the DFM time) then the detector will be assumed to be faulty. The DFM time setting must take account of times of low crossing usage such as during holidays times, so it may be set to be up to 18 hours. If required, further sophistication is able to be configured to provide a 'Holiday Clock' feature so that DFM times could be set up more precisely to account for such special days. For example, during the day the DFM time is short, e.g. 30 minutes, whereas at night this should be longer, e.g. 2 hours, and on holidays e.g. 8 hours.

[0022] Similarly, the train approach detectors may be included in the DFM system and be validated by their regular activation by trains.

[0023] The actions taken on the failure of a detector may be configured in the system and range from simply logging the fault, through to activating a sending of a regular GSM-R voice message warning approaching trains that the system is not functioning properly.

[0024] Alternatively, the system can send a warning to the rail network maintenance team who will notify the signaller, who can then notify train drivers if required. In this case the warning can be a data message rather than a voice message. Barrier Monitoring: If volt free contacts are available to indicate when the barriers are down and also when the Wig-Wag signals are operational, an additional level of monitoring may be provided. If the barrier down confirmation is not received within a configurable time after the wig-wag signals show red, an Emergency Group Call message will be automatically generated by the processor unit, wherein the message will contain a warning that the crossing barriers may not be down, together with the crossing name. It is to be noted that if an emergency call is made, all trains will automatically stop and can then be advised by the signaller to proceed at caution.

[0025] Protection against vehicles turning onto the tracks: With the wide use of mobile satellite navigation systems in cars and trucks, the number of incidence of drivers accidentally turning onto tracks at rail crossings located very close to road intersections, mistaking the tracks for a road turning and then becoming stuck there, has increased. This type of incident is even more prevalent at night.

[0026] As shown in FIG 2, additional detectors are added at the rail crossings to cover the tracks in proximity to

the crossing, it is possible to provide a degree of protection against this eventuality.

[0027] These additional detectors which each cover an on-track detection zone are used by the system to observe the presence of an obstruction on the tracks whenever the barriers are up. This system will the monitor the on-track detectors whenever the barriers are up and A potential hazard situation will be logged if a presence is observed for more than a configurable time, for example nominally a few seconds).

[0028] The system can then send a Emergency Group Call message to warn approaching trains that there is a potential hazard such as a vehicle on the track. The message will contain the crossing name or an identifier of the crossing, to ensure that if more than one train is within group call area, it is clear which trains may be at risk. This message may for example be repeated every 30 seconds whilst the presence continues to be detected, but the timing may be configurable.

System at Automatic Open Crossings Locally Monitored (AOCL)

[0029] These will be monitored as for the AHB crossing except the system may be engaged by the Wig-Wag active signal after a configurable delay.

System at User Worked Crossings Protected by Miniature Warning Lights

[0030] As shown in FIG 3, for double tracked sections the system can be configured similar to the AHB topography but it is likely that dedicated poles are required to mount the detectors as there are not Wig-Wag poles available. In addition, it is possible that local mains power will also not be present so a combination of solar and/or wind power source for powering the detectors, processor unit and GSM-R radio module may be required.

[0031] In this specific configuration, it would be required to generate an 'activate' signal from the red miniature warning signal. This may be realised by inserting a relay in the lamp power line or to use an optical sensor to detect when the warning light is lit.

[0032] For single track sites, shown in FIG 4, the overall topography may be arranged so that all equipment is provided on the same side of the tracks, eliminating the need to cable across them.

Passive Crossings

[0033] Passive crossing may be protected in a similar fashion to User Worked crossings described above. However, in these cases there is usually no indication at the crossing that a train is approaching, consequently a simple radar detector is located along the track at sufficient distance to give adequate warning of the approaching train. The distance is dependent on track speed but should allow for for example at least 40 seconds notice of the oncoming train.

[0034] Physical cables may be used to link the detectors to the system, but alternatively, this may also be done using wireless equipment.

[0035] Although the foregoing description refers to GSM-R, the described invention may also be implemented in the same way using other radio communication systems or standards, for example a rail specific adaptation of communication system based on the UMTS (Universal Mobile Telecommunication Standard) standard as an evolutionary step from the well-known GSM-R standard.

Claims

1. Rail crossing system, comprising at least
means for detecting an obstruction on the rail crossing, and means for sending an information to at least one train approaching the crossing, wherein the sending of the information to the train is realised using a radio communication network.

2. Rail crossing system according to claim 1, wherein the radio communication network is realised as a network employing a GSM or GSM-R based radio communication standard or an evolution thereof.

3. Rail crossing system according to claim 1 or 2, wherein
a radio communication protocol based on the GSM-R radio communication standard is used for sending the information.

4. Rail crossing system according to claim 3, wherein an Emergency Group Call is used for sending the information.

5. Rail crossing system according to any of the preceding claims, wherein
at least one first radar detector is used to detect the obstruction on the rail crossing.

6. Rail crossing system according to any of the preceding claims, wherein
at least one second radar detector is used to detect trains approaching the rail crossing.

7. Rail crossing system according to claim 6, wherein the at least one second radar detector is positioned at or in proximity to the rail crossing.

8. Rail crossing system according to claims 5 and 6, wherein the at least one first radar detector is disabled if it is determined by the at least one second radar detector that the at least one train passes through the crossing.

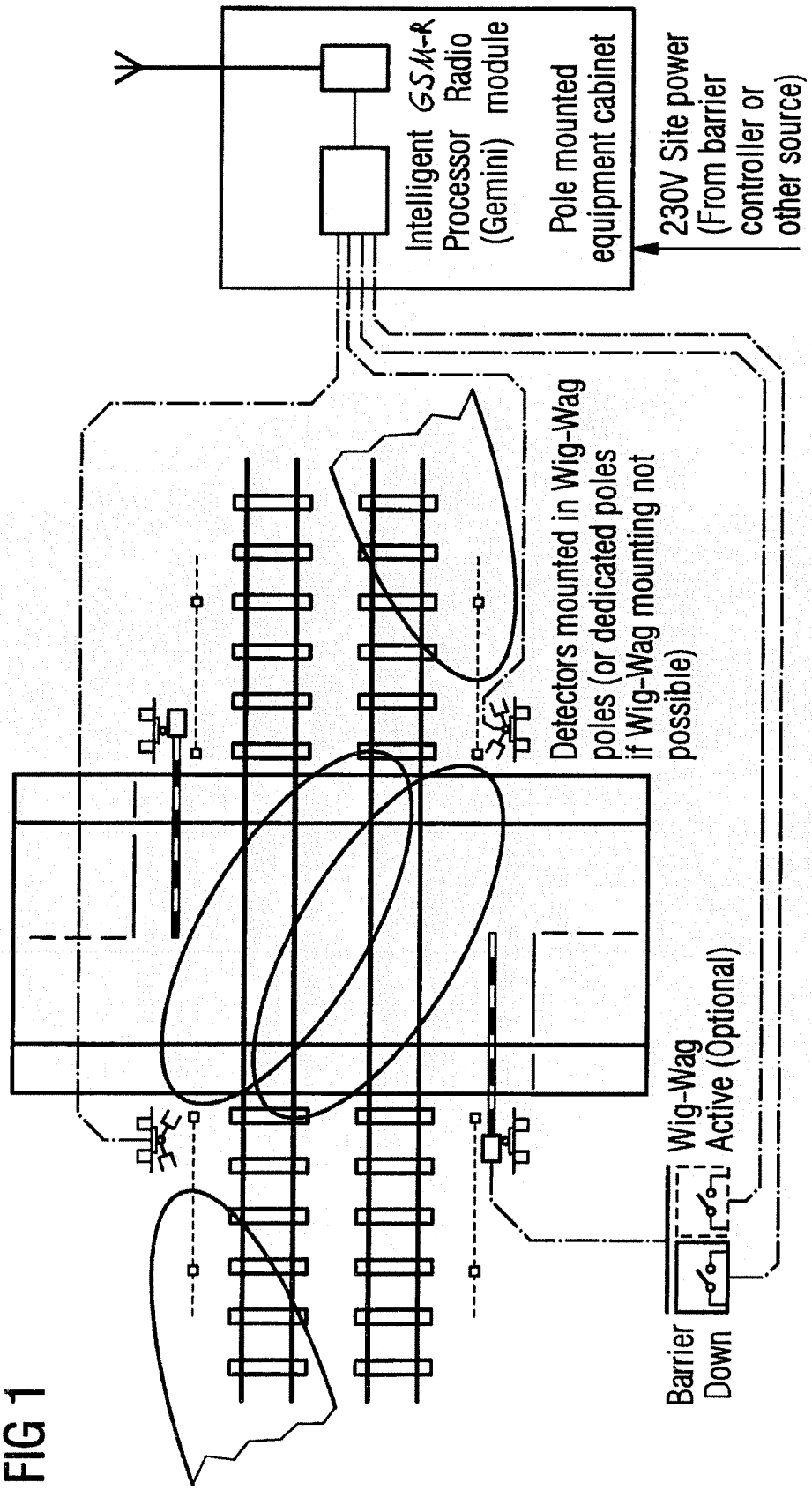
Intelligent GSM-R Processor Radio (Gemini) module
Pole mounted equipment cabinet
230V Site power (From barrier controller or other source)
Detectors mounted in Wig-Wag poles (or dedicated poles if Wig-Wag mounting not possible)
Wig-Wag Active (Optional)
Barrier Down

FIG 1

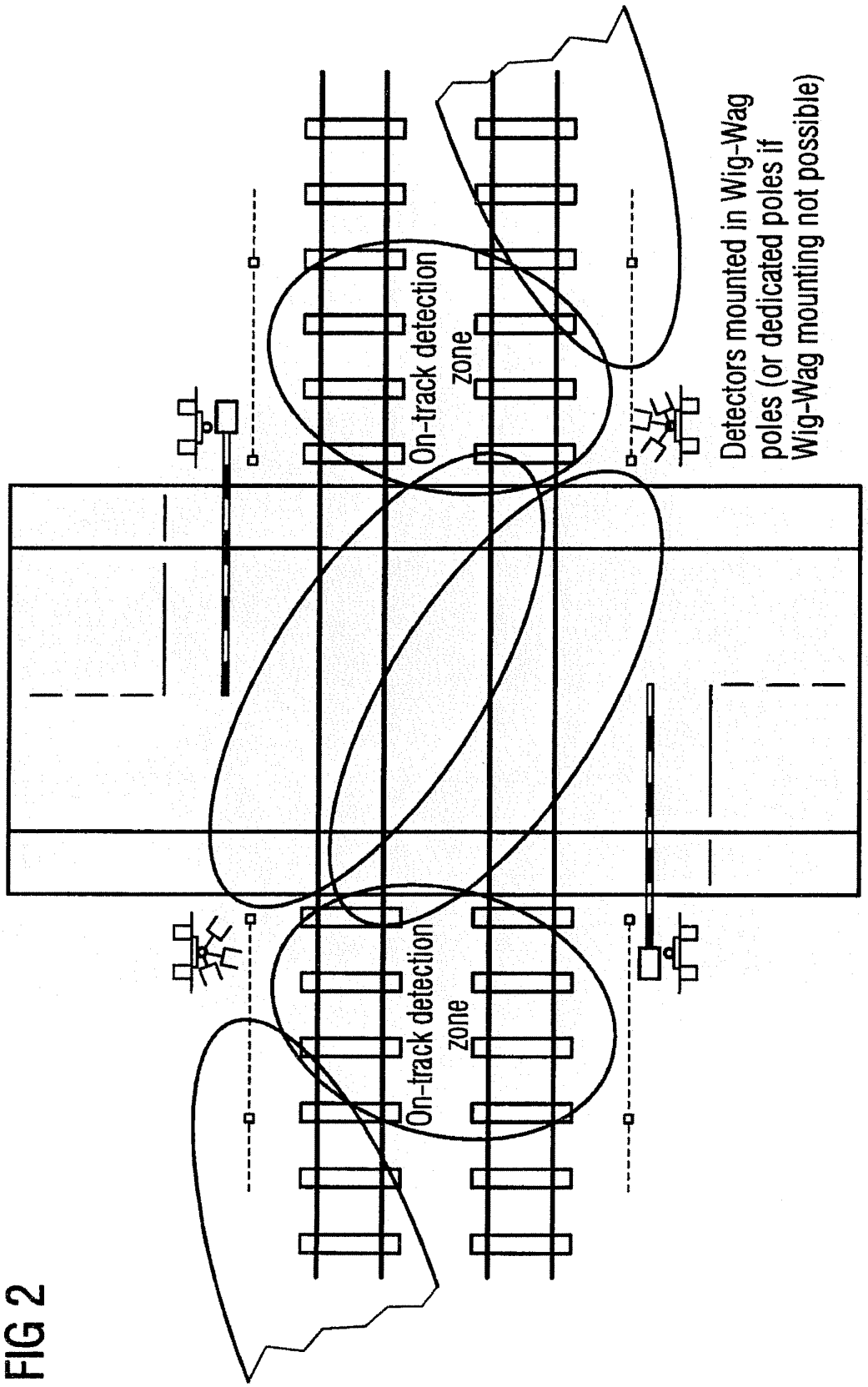
On-track detection zone
On-track detection zone
Detectors mounted in Wig-Wag poles (or dedicated poles if Wig-Wag mounting not possible)

FIG 2

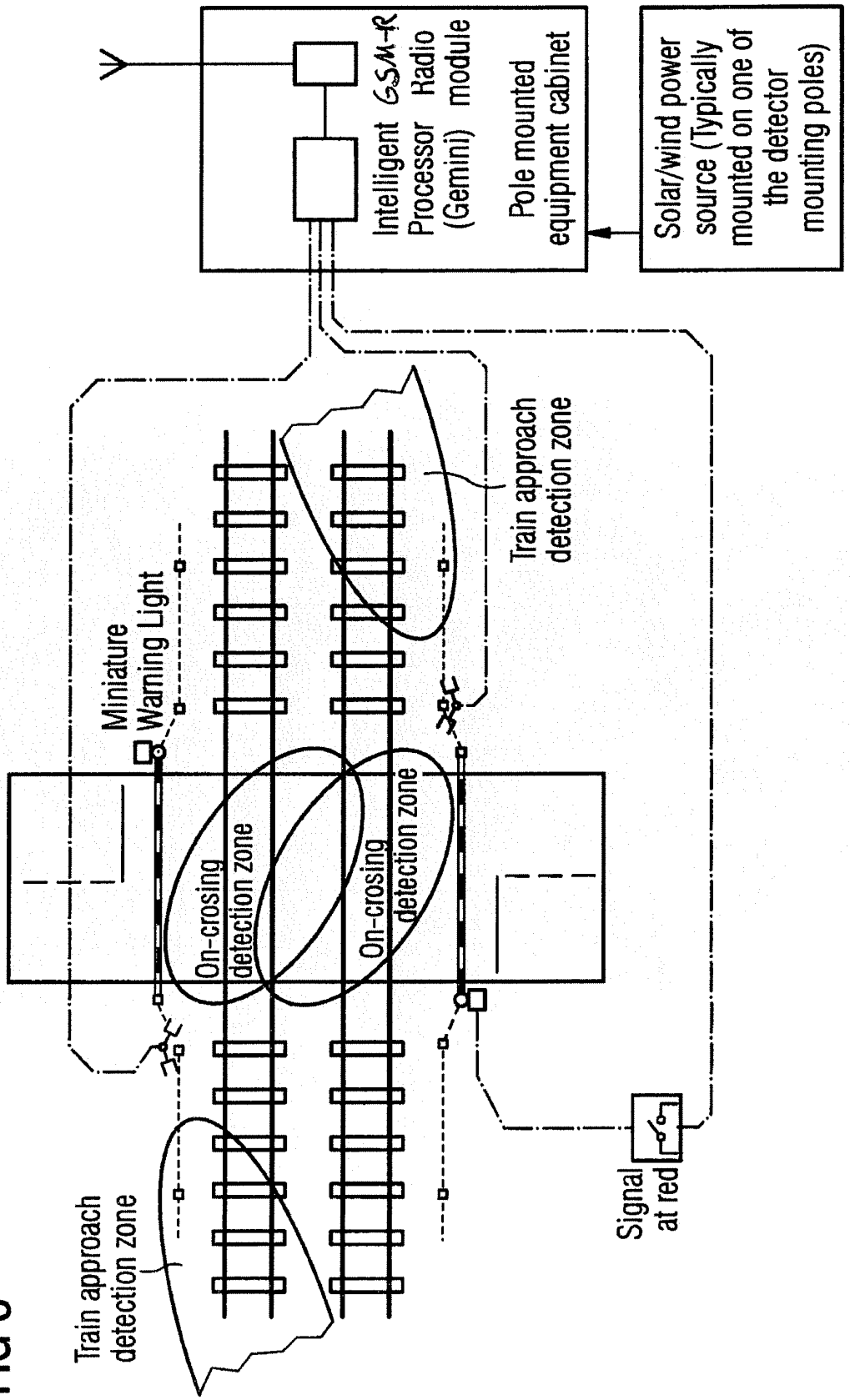
Intelligent GSM-R Processor Radio (Gemini) module
Pole mounted equipment cabinet
Solar/wind power source (Typically mounted on one of the detector mounting poles)
Train approach detection zone
Miniature Warning Light
On-crosing detection zone
On-crosing detection zone
Train approach detection zone
Signal at red

FIG 3

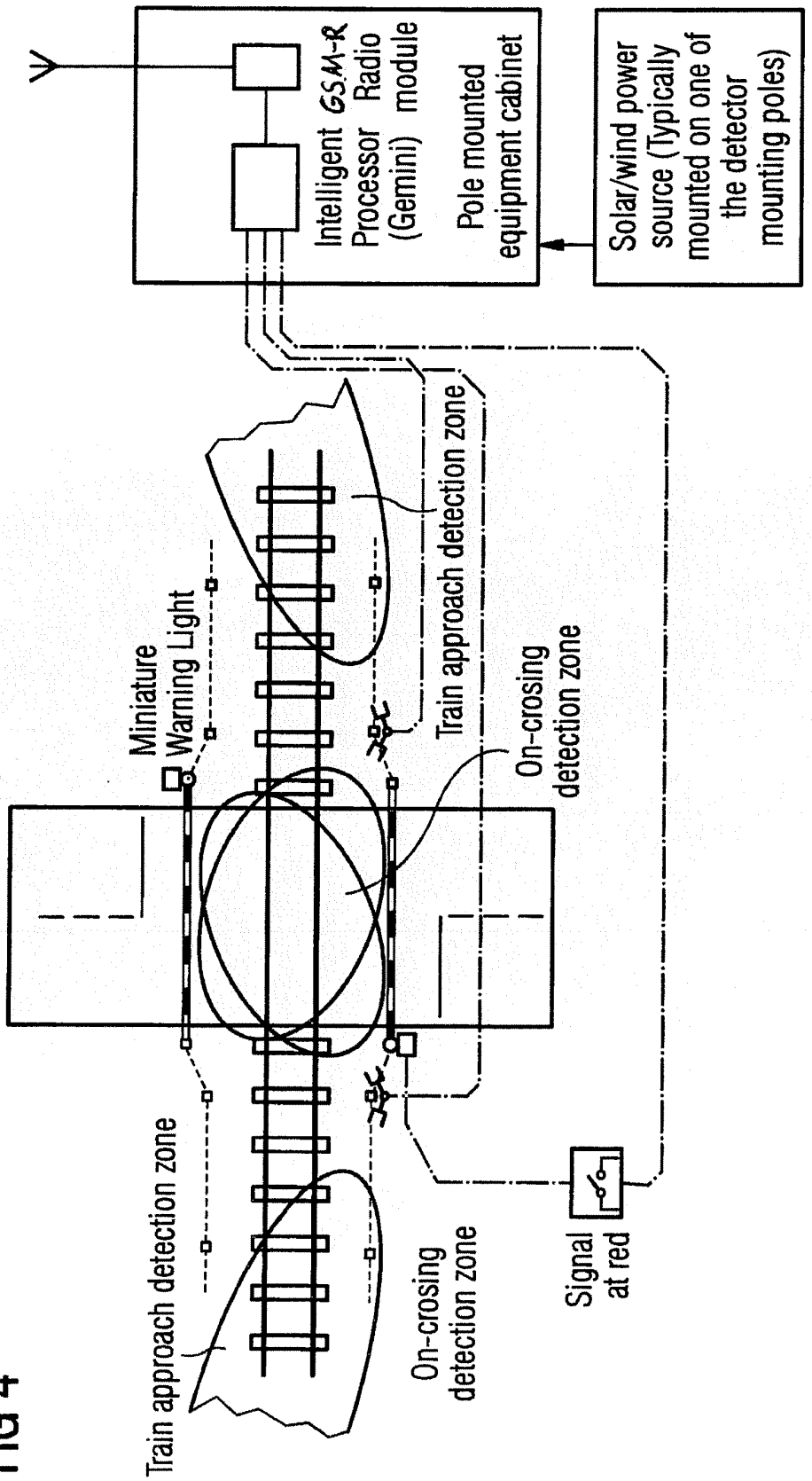
Intelligent GSM-R Processor Radio (Gemini) module
Pole mounted equipment cabinet
Solar/wind power source (Typically mounted on one of the detector mounting poles)
Miniature Warning Light
Train approach detection zone
On-crosing detection zone
Train approach detection zone
On-crosing detection zone
Signal at red

FIG 4

REFERENCES CITED IN THE DESCRIPTION

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- WO 2007134430 A1 **[0005]**
- US 5864304 A **[0005]**
- FR 2784342 **[0005]**

Non-patent literature cited in the description

- *Heimdall traffic detector family* **[0009]**