Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2885132 C 2021/01/12

(11)(21) 2 885 132

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2015/03/13

(41) Mise à la disp. pub./Open to Public Insp.: 2015/09/25

(45) Date de délivrance/Issue Date: 2021/01/12

(30) Priorité/Priority: 2014/03/25 (FR14 52 516)

(51) Cl.Int./Int.Cl. *B61L 27/00* (2006.01)

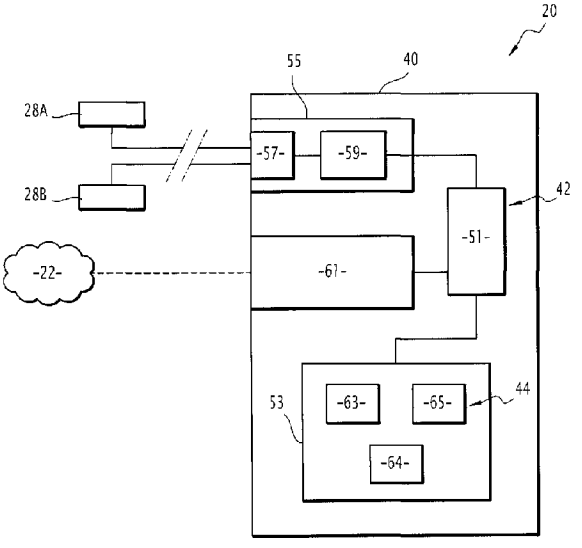
(72) Inventeurs/Inventors:
BRESSON, MATHIEU, FR;
PERROT, JOCELYN, FR;
VENENCIE, JEAN-LOUIS, FR

(73) Propriétaire/Owner:
ALSTOM TRANSPORT TECHNOLOGIES, FR

(74) Agent: ROBIC

(54) Titre : EQUIPEMENT POUR SYSTEME DE DETECTION DE RAIL SECONDAIRE ET MECANISME DE SIGNALISATION INTEGRANT UN TEL EQUIPEMENT

(54) Title: EQUIPMENT FOR A SECONDARY RAIL DETECTION SYSTEM AND SIGNALIZATION SYSTEM INTEGRATING SUCH EQUIPMENT



(57) Abrégé/Abstract:
The equipment (20) according to the invention for a rail detection system of an automatic railroad traffic control architecture is associated with a zone of a railroad track and able to generate release information for said zone, from signals received from sensors (28A; 28B).
The equipment (20) comprises a hardware layer (42) comprising an input interface (55) for producing a digital signal from the delivered signals, and a communication board (61) for communicating with a network (22) to allow communication with an interlocking system.
The equipment (20) comprises a software layer (44) comprising application software (63) for acquiring the digital signal and generating release information, and pilot software (65) for sending said information to the interlocking system.

ABSTRACT

The equipment (20) according to the invention for a rail detection system of an automatic railroad traffic control architecture is associated with a zone of a railroad track and able to generate release information for said zone, from signals received from sensors (28A; 28B).

The equipment (20) comprises a hardware layer (42) comprising an input interface (55) for producing a digital signal from the delivered signals, and a communication board (61) for communicating with a network (22) to allow communication with an interlocking system.

The equipment (20) comprises a software layer (44) comprising application software (63) for acquiring the digital signal and generating release information, and pilot software (65) for sending said information to the interlocking system.

Equipment for a secondary rail detection system and signalization system integrating such equipment

The present invention relates to equipment for a secondary rail detection system of an interlocking system for a signalization system.

The present invention more particularly relates to an automatic train control architecture for trains traveling on a railroad network. Such an architecture is referred to as Automatic Train Control (ATC).

In a known manner, an ATC architecture comprises different systems cooperating with each other to allow trains to travel safely on the network.

Different ATC architectures exist; however, the present invention more specifically relates to an ATC architecture of the "communication-based train control" (CBTC) type. A CBTC architecture is diagrammatically illustrated in figure 1.

A CBTC architecture is based on the presence of computers onboard the trains. The computer 26 of a train determines a certain number of operating parameters and communicates with various systems on the ground to allow the train to perform its assigned mission safely. This computer on the one hand covers the functional needs of the train, i.e., for example the stations to be served, and on the other hand controls safety points, i.e., for instance verifies that the train is not traveling at an excessive speed. The computer 26 of a train is at least connected to an onboard radio communication unit 27, able to establish a radio link with base stations 25 of a communication infrastructure, which in turn is connected to a communication network 29 of the CBTC architecture.

On the ground, the CBTC architecture comprises a zone controller (ZC) referenced by figure 50 in figure 1. This zone controller 50 is in particular responsible on the one hand for monitoring the presence of the trains on the railroad network, and on the other hand, in a centralized architecture, for providing movement authorizations to the trains that are of a nature to guarantee their safe movement, i.e., for example not to give a train a movement authorization that would cause it to go past the train preceding it.

The CTC architecture is part of an overall system, called signaling system (SS in figure 1), that is also able to command a plurality of pieces of equipment on the track.

The signaling system comprises an automatic train supervision (ATS) system. The ATS system is implemented in an operational unit and comprises man / machine interfaces, allowing operators to intervene on the various systems of the signaling system and, in particular, the trackside equipment. For example, the operator can remotely control closing of the signal (turning a light red) from the ATS.

The signaling system also comprises an interlocking system. Such an interlocking system is able to manage the trackside equipment, such as signal lights, switching actuators, etc., that trackside equipment allowing the trains to move safely and avoiding conflicting movements between them. Once based on electromechanical relays, today the interlocking system is computerized by suitable computers able to command the trackside equipment. Such an interlocking computer is referenced by number 19 in figure 1.

The railroad network is made up of railroad track sections, each track section being subdivided into zones. In figure 1, three successive zones 14A, 14B and 14C are shown.

The occupancy of a zone of a track section is a key piece of information for railroad security. The determination of that information will now be described.

The zone controller receives information on the one hand from a primary detection system, and on the other hand from a secondary detection system.

The primary detection system makes it possible to determine the zone occupied by a train based on the instantaneous position of the train determined by the train itself. More specifically, the zone controller receives the instantaneous position of a train from each computer 26 onboard that train 16. This position is determined by the onboard computer from the detection of beacons 24 placed along the track 12 and whose geographical positions are known, and from odometry means equipping the train and allowing the computer 26 to determine the distance traveled by the train since the last beacon crossed. In another embodiment, the train uses other means to determine its position: for example, an accelerometer (in place of the odometer) or a GPS (in place of the beacons). From the instantaneous position of the train, the zone controller uses a geographical map of the network, on which each zone is uniquely identified, to deduce the zone in which the train is currently located. A first state E1 of the zone in which the train is located then assumes the "occupied" value.

It should be noted that for safety reasons, according to the primary detection system, not only is the zone in which the train is located in the "occupied" state, but the adjacent zones before and after that central zone are as well, so as to define a safety area around the train. That additional area covers the maximum distance that the train can travel between the time when it calculates the position that it will send to the zone controller and the time when that zone controller receives the information.

Furthermore, as long as no other position information is received by the zone controller, the latter continues to extrapolate the position of the train to cover its potential movements.

The first state E1 of the zones in which no train is located at the current moment assumes the "free" value.

In this way, a first piece of occupancy information for each zone is determined by the zone controller.

The secondary detection system is able to back up the primary detection system; for instance, in the event the radio communication unit 27 of a train 16 is no longer working, the zone controller 50 cannot obtain the instantaneous position of the train. It is important to note that a "purely" CBTC system can operate with only the primary detection. The secondary system is, however, important on the one hand to cover the failure modes of the CBTC communication, and on the other hand to allow trains not equipped with CBTC to travel on the same railroad network.

Using suitable track equipment, positioned alongside the track, the secondary detection system is able to detect the presence of a train in a given zone.

In a first embodiment, the secondary detection system is based on counting the number of axles of a vehicle passing in front of an axle sensor situated at each end of the considered zone. This system is referred to as an “Axle Counter". Thus, when a vehicle enters a zone, the entry sensor, situated at the entry of that zone, allows the incrementation of a state counter associated with that zone, each time the passage of an axle of the vehicle is detected. When the vehicle leaves the considered zone, the exit sensor, situated at the exit from that zone, makes it possible to decrement the same state counter by one unit, each time the passage of an axle of the vehicle is detected. Thus, the zone is in the "free" state when the state counter associated with that zone is equal to zero. Otherwise, the zone is in the "occupied" state.

In a second embodiment, the secondary detection system comprises a sensor of the track circuit type. This sensor makes it possible to detect the presence of a short-circuit when each line of rails of the considered zone is powered on. In fact, if a vehicle is present in that zone, the axle of the vehicle electrically connects the two rail lines and creates a short-circuit. Thus, detecting a short-circuit makes it possible to place a binary state counter at the unit value corresponding to the "occupied" state of the zone. Otherwise, the state counter assumes the zero value and the zone is in the "free" state.

In these two embodiments, the secondary detection system comprises, aside from a plurality of tracks sensors, a plurality of intermediate equipment items making it possible to use analog measurement signals at the output of the sensors to generate occupancy information for the track that can be sent to the interlocking system. Thus, the interface between the tracks sensors and the interlocking system can be broken down into two parts:

- an "upstream" part, which connects the tracks sensors to a piece of detection equipment. This part is made up of a cable connecting the sensors to the detection equipment, which in turn is made up of electromechanical relays making it possible to acquire analog signals at the output of the sensors, and allowing the implementation of occupancy state sensors for the corresponding zones by controlled switches;
- a "downstream" part, which connects the detection equipment to the interlocking system. This part is able to emit a read signal of the occupancy state sensor of a zone of the detection equipment, generate a suitable message comprising the occupancy information, and send it to the interlocking system. In the state of the art, this downstream part is also made up of pieces of equipment composed of electromechanical relays and electronic boards for interfaces with the interlocking system.

In general, these intermediate pieces of equipment are installed in a technical site arranged to that end at the edge of the railroad track.

The secondary detection system of the state of the art has a certain number of drawbacks.

In particular, the intermediate equipment of the secondary detection system is expensive, bulky and difficult to install and maintain. In particular, the second so-called "downstream" part for interfacing with the interlocking system is complex.

The present invention aims to resolve the aforementioned problems. It in particular aims to propose an interface between sensors and an interlocking system for a secondary ground detection system that is more compact, less expensive, easier to install and easy to maintain. The present invention aims to simplify the second so-called "downstream" part of such an interface by drastically decreasing the necessary number of components. This simplification involves modifying the detection equipment of the so-called "upstream" part of that interface.

To that end, the invention relates to a piece of detection equipment for a secondary rail detection system of an automatic railroad traffic control architecture on a railroad track, said railroad track being subdivided into a plurality of zones, said equipment being associated with at least one particular zone, and being able to generate release information for said particular zone that by a vehicle traveling on the track, from at least one measurement signal received from at least one sensor of the secondary detection system connected to said equipment, wherein said equipment is a computer, comprising:

- a hardware layer, comprising:
  - computation means;

- storage means;
- an input interface comprising: a connector, to connect said at least one sensor to said equipment, and digitization means, to produce a digital signal from the measurement signal delivered by said at least one sensor;
- a communication board, to connect the equipment to a communication network and allow direct two-way communication between the equipment and an interlocking system of a signaling system to which said automatic traffic control architecture belongs, said interlocking system being connected to the communication network;

- a hardware layer, comprising:
  - application software, able to acquire the digital signal of the entry interface and generate release information for said particular zone;
  - pilot software, able to generate a data message from said release information of said particular zone, the data message respecting a secure communication protocol, and to pass the data message to the communication board so that it sends that data message over the communication network to the interlocking system.

According to other advantageous aspects of the invention, the equipment comprises one or more of the following features, considered alone or according to all technically possible combinations:

- said sensor of the secondary detection system is a track circuit sensor, said connector and said application software being adapted to that sensor;

- said sensor of the secondary detection system is an axle sensor, said connector and said application software being adapted to that sensor;

- said communication board is a communication board of the ETHERNET type;

- said secure communication protocol is the protocol defined by standard $FSFB_2$;

- said pilot software is able to command a reset of the release information for said particular zone from a reset message coming from said interlocking system and received by said communication board.

The invention also relates to a signalization system for a railroad track comprising: a communication network, preferably of the ETHERNET type; an interlocking system for controlling the traffic of the vehicles traveling on the track; and an automatic control architecture for the railroad traffic on the track, the architecture being of the type based on control of the vehicles by onboard computers, said railroad track being subdivided into a plurality of zones, said architecture comprising:

- a primary detection system, to detect the presence of a vehicle on at least one particular zone from a determination of the position of the vehicle done by a computer onboard said vehicle, the primary detection system being able to generate a first piece of release information; and

- a secondary track detection system, to detect the presence of a vehicle on at least one particular zone of the track, comprising a sensor situated along the track, associated with said particular zone and able to generate a measurement signal, said secondary detection system being able to generate a second piece of release information and communicate it to the interlocking system, the secondary detection system being independent from the primary detection system,

wherein the secondary detection system comprises a piece of equipment according to any one of the preceding claims, the entry interface of which is connected to said at least one sensor and the communication board of which is directly connected to the interlocking system, via the communication network.

The invention will be better understood using the following description, provided solely as a non-limiting example and done in reference to the appended drawings, in which:

- figure 1 is a diagrammatic view of an automatic railroad traffic control architecture on a railroad track according to the invention and a vehicle traveling on that railroad track;

- figure 2 is a diagrammatic view of a piece of equipment of the secondary track detection system of the architecture of figure 1.

The signalization system 10 for a railroad track 12 is illustrated in figure 1.

The railroad track 12 is divided into a plurality of sections, each section being subdivided into a plurality of zones on which the railroad traffic is monitored. Figure 1 illustrates a section of the railroad track 12, which is subdivided into three zones designated by reference is 14A, 14B and 14C.

Each zone 14A, 14B or 14C comprises an identifier making it possible to distinguish it uniquely and certainly from the set of zones of the track 12.

Figure 1 further illustrates a vehicle 16 traveling on that railroad track 12. The vehicle is illustrated at the time when it enters the zone 14B: it crosses a first border 18A, situated between the zones 14A and 14B and making up an entry border for the zone 14B, and moves toward a second order 18B, situated between the zones 14B and 14C and constituting an exit border for the zone 14B.

"Vehicle" refers to any vehicle able to travel on the railroad track 12.

The vehicle 16 comprises a plurality of axles, at least one wheel for each line of rails of the railroad track 12 being mounted on each axle to allow the vehicle 16 to move

along the railroad track. The axles and the wheels are made from an electrically conductive material. In figure 1, the vehicle 16 comprises four axles designated by references 17A, 17B, 17C and 17D.

The signalization system 10 comprises an interlocking system 19 to control the travel of the vehicles traveling on the railroad track 12, and in particular that of the vehicle 16. Such an interlocking system of the railroad track 12 is also referred to in the state of the art as interlocking.

The interlocking system 19 is able to drive the operation of a plurality of pieces of equipment distributed along the track 12, only one piece of detection equipment 20, described in more detail below, being shown in figure 1. Thus, for example, such pieces of equipment assume the form of switching actuators, signalization lights or other electromechanical devices known in themselves in the state of the art.

The interlocking system 19 for example comprises a plurality of computers able to analyze and control the railroad traffic on the railroad track automatically or semi-automatically. The interlocking system 19 is situated away from the equipment of the railroad track 12 and is connected thereto by a suitable communication network 22, preferably of the ETHERNET type.

The signalization system 10 comprises an automatic traffic control architecture for trains on the track, which is an architecture of the communication-based train control (CBTC) type.

This architecture comprises a zone controller 50 able to reconcile the occupancy information of the track from a primary detection system and a secondary detection system.

This architecture thus comprises a primary detection system SPD using beacons 24A, 24B or 24C. The latter are respectively situated in zones 14A, 14B and 14C and are able to send their precise geographical position to a computer 26 onboard the vehicle 16.

The instantaneous position is computed by the computer 26, from the geographical position of the last beacon crossed, which is updated with the measurement of the path traveled by the vehicle since the last beacon crossed, obtained using odometer means equipping the vehicle 16.

The vehicle 16 further comprises onboard radio communication units 27, able to send and receive wireless signals with base stations 25 positioned on the ground along the track 12. These base stations 25 are connected to a communication network 29 of the system 10.

The units 27 allow communication to the zone controller 50 of a message comprising the instantaneous position and an identifier of the vehicle 16, making it

possible to distinguish it uniquely and certainly from other vehicles traveling on the track 12.

Based on the track layout plan, i.e., the subdivision into geographically identified zones of the track 12, and the instantaneous position of the vehicle 16, the zone computer 50 determines the identifier of the zone in which the vehicle is located. It associates the "occupied" state with that zone.

In order to offset a failure of the primary detection system SPD or to allow the travel of trains not equipped with CBTC on the same railroad network, the primary detection system SPD is backed up by a secondary detection system SSD, which is able to detect the occupancy state of the zones of the track 12 through a direct measurement of the presence of the vehicle in each zone.

The architecture thus comprises a secondary detection system SSD to detect the presence or absence of a vehicle in the zones 14A, 14B and 14C of the railroad track 12. The secondary detection system SSD generates a second piece of occupancy information that is communicated to the zone computer 50.

The secondary detection system SSD comprises a plurality of sensors and a plurality of pieces of detection equipment 20.

In a first embodiment shown in figure 1, the secondary detection system SSD comprises axle sensors. In order to determine the occupancy state of the zone 14B, an entry sensor 28A and an exit sensor 28B are placed along the track at the first border 18A and the second border 18B of the zone 14B, respectively. Each sensor 28A or 28B is a counting head able to send a measurement signal when an axle crosses the border 18A or 18B, respectively. The measurement signal is for example a short-lasting pulse.

Each zone of the track 12 is associated with an entry sensor and an exit sensor. Advantageously, to reduce costs, the exit sensor of the zone is also the entry sensor of the next zone.

It should be noted that in figure 1, a zone is a track portion with two ends, but it could be a zone comprising several entry and/or exit ends, such as a zone corresponding to a switch.

The two sensors of a zone are connected to the input of a piece of detection equipment 20. More particularly, for the case of the zone 14B, the sensors 28A and 28B are directly connected to the detection equipment 20 by wired connections.

In the example embodiment shown here in detail, the detection equipment is dedicated to one zone. It is therefore associated with a pair of sensors. Alternatively, a piece of detection equipment is shared by a plurality of zones that are geographically adjacent to one another. The sensors of each of the zones are connected to the input of

the detection equipment, which measures the occupancy state of each of those zones at each moment.

The detection equipment 20 is also directly connected to the interlocking system 19, via a communication network 22.

The detection equipment 20 is able to acquire the measurement signals coming from a pair of sensors, and process them so as to determine an occupancy state of the corresponding zone and send the occupancy information to the interlocking system 19 via the communication network 22.

The interlocking system 19 relays this information and sends it to the zone controller 50, via the communication network 29 of the system 10.

The equipment 20 is illustrated in more detail in figure 2.

Thus, as illustrated in this figure 2, the equipment 20 is a computer 40 comprising a hardware layer 42 and a software layer 44.

The hardware layer 42 comprises a computation means 51 and a storage means 53. The storage means 53 is for example a memory able to store the instructions for a plurality of software programs. The computation means 51 is for example a processor able to execute the software stored in the storage means 53.

The hardware layer 42 further comprises an input interface 55. The input interface comprises a plurality of connectors 57, each connector 57 making it possible to connect the equipment 20 to a sensor, such as the sensors 28A and 28B. The input interface comprises digitization means 59 to produce a digital signal from an analog measurement signal coming from a sensor 28A or 28B.

The hardware layer 42 further comprises a communication board 61 of the ETHERNET type to connect the equipment 20 to the communication network 22. This communication board 61 thus allows direct two-way communication between the detection equipment 20 and the interlocking system 19, through the communication network 22.

In the prior art, the hardware means for connecting the detection equipment to the interlocking system is not a communication board, but a digital/analog conversion board able to generate a digital/analog signal that is sent, through a plurality of pieces of wired intermediate equipment (such as relays able to perform an impedance adaptation), to intermediate input equipment on the interlocking system. This input equipment comprises input boards connected by a communication network to the interlocking system. Thus, the present detection equipment eliminates the many intermediate layers between the sensors and the interlocking system 19.

The software layer 44 comprises an application software program 63 stored in the storage means 53. When it is executed, the application software 63 is able to acquire the

digital signals provided at the output of the digitization means 59, and from the signals, for each zone of the track with which the equipment 20 is associated, to keep a state counter up to date and generate occupancy information as a function of the current value of that state counter.

The state counter of a zone for example assumes the form of an integer variable 64, associated with that zone and stored in the storage means 53. The application software 63 is able to increment or decrement the value of that variable 64 as a function of the measurement signals coming from the sensors associated with that zone or a reset message MR coming from the interlocking system 19 via the communication network 22.

For security reasons, the occupancy information is in reality done in the form of its inverse state, i.e., release information. The release information is a binary property assuming a "false" value when the state counter is different from zero, the corresponding zone being in the "occupied" state, and a "true" value when the state counter is equal to zero, the corresponding zone being in the "free" state.

The software layer 44 further comprises a pilot software program 65 stored in the storage means 63 and able to generate a data message MD from the release information generated by the application software 63 and the identifier of the corresponding zone.

The data message MD is generated by the pilot software so as to respect a secure communication protocol, for example the $FSFB_2$ (Fail Safe Field Bus 2nd generation) protocol. This protocol in particular makes it possible to send the data message MD, via the communication network 22, with a requisite security level for railroad applications.

The pilot software 65 is able to pass the data message MD to the communication board 61 so that the latter sends it to the interlocking system 19 via the communication network 22.

The pilot software 65 is also able to reset the state counter of a zone, i.e., to reset the corresponding variable 64, from a reset message MR sent by the interlocking system 19 and received via the communication network 22 and the communication board 61.

The operation of the equipment 20 according to the first embodiment of the invention will now be explained.

Initially, no vehicle traveling in the zone 14B of the railroad track 12, the state counter associated with that zone is equal to zero, corresponding to the initialization value. The zone 14B is therefore in the "free" state.

When the vehicle 16 enters the zone 14B by crossing the first border 18A, the entry sensor 28A detects the first axle 17A and sends a measurement signal corresponding to the detection of an axle to the input interface 55 of the equipment 20.

This measurement signal is next converted into a digital signal by the digitization means 59 and is processed by the application software 63 executed by the computation means 51.

Thus, the application software 63 increments the variable 64 by one unit. The state sensor being non-zero, the occupancy state switches to the "occupied" state.

If the variable 64 is different from zero, the pilot software 65 generates a data message MD comprising the "false" release information indicating the "occupied" state of the zone 14B and the identifier of the zone 14B. It next sends that message MD to the interlocking system 19.

Similarly, upon each passage of one of the axles 17B, 17C or 17D, the variable 64 is incremented by one unit. Thus, in the embodiment of figure 1, after the passage of all of the axles of the vehicle 16, the variable 64 is equal to "4".

When the first axle 17A of the vehicle 18 crosses the second border 18B of the zone 14B, the exit sensor 28B sends a measurement signal to the input interface 55 of the equipment 20.

This measurement signal is next converted into a digital signal that is processed by the application software 63. Once it is received, the application software 63 decrements the variable 64 by one unit.

Similarly, upon each passage of an axle 17B, 17C or 17D, the variable 64 is decremented by one unit.

Whenever that variable is once again equal to zero, the pilot software 65 generates a data message MD comprising the "true" release information, indicating that the occupancy state of the zone 14B is "free", and the identifier of the zone 14B. This message MD is sent to the interlocking system 19.

The zone 14B is considered by the interlocking system 19 to be free until a message MD is received indicating that the state is "occupied".

If the equipment 20 receives a reset message MR from that interlocking system 19, the variable 64 is reset to its initialization value, i.e., zero. The message MR thus comprises the identifier of the zone whose status counter must be reset.

According to a second embodiment (not illustrated), the operation of the secondary detection system SSD to detect the presence of the vehicle in a zone is based on a track circuit associated with that zone, also known in the state of the art as a Track Circuit.

In this embodiment, the lines of rails of the railroad track are connected to each other by electrical conductors placed at the entry and exit borders of a zone to obtain an electric circuit forming a loop.

The secondary detection circuit SSD comprises a sensor making it possible, when that loop is turned on, to detect the presence of a short-circuit in that loop created by an axle of a vehicle.

The measurement signal sent by that sensor to the input interface of the equipment, once digitized, is processed appropriately by the application software.

That measurement signal for example corresponds to the impedance value of the electric circuit. Thus, a variation of that value allows the application software to determine the occupancy state of that zone.

More particularly, if that variation is outside a predetermined interval for the corresponding zone, the pilot software generates a data message comprising the "false" release information, indicating that the occupancy state of the zone is "occupied", and the identifier of the zone. That message is sent to the interlocking system. When that variation is again situated in the predetermined interval, the pilot software generates a data message comprising the "true" release information, indicating that the occupancy state of the zone is "free", and the identifier of the zone, to send that message to the interlocking system.

The particular advantage of the detection equipment and its interfacing with the interlocking system lies in its smaller dimensions relative to those of the various component equipment items of a secondary detection system of the state of the art. Furthermore, the equipment, as well as its interfacing with the interlocking system, can be installed easily and is particularly simple to maintain. The associated manufacturing cost and the operating cost are particularly low. This equipment may further be easily adapted to different communication protocols and different control architectures through a simple modification of its software layer.

CLAIMS

1.- A piece of detection equipment (20) for a secondary rail detection system (SSD) of an automatic railroad traffic control architecture on a railroad track (12), said railroad track (12) being subdivided into a plurality of zones (14A; 14B; 14C), said equipment being associated with at least one particular zone (14A; 14B; 14C), and being able to generate release information for said particular zone (14A; 14B; 14C) that by a vehicle (16) traveling on the track (12), from at least one measurement signal received from at least one sensor (28A; 28B) of the secondary detection system connected to said equipment (20);

wherein said equipment (20) is a computer (40), comprising:

- a hardware layer (42), comprising:
  - computation means (51);
  - storage means (53);
  - an input interface (55) comprising: a connector (57), to connect said at least one sensor (28A; 28B) to said equipment, and digitization means (59), to produce a digital signal from the measurement signal delivered by said at least one sensor;
  - a communication board (61), to connect the equipment (20) to a communication network (22) and allow direct two-way communication between the equipment (20) and an interlocking system (19) of a signaling system to which said automatic traffic control architecture belongs, said interlocking system being connected to the communication network (22);
- a hardware layer (44), comprising:
  - application software (63), able to acquire the digital signal of the entry interface and generate release information for said particular zone (14A; 14B; 14C);
  - pilot software (65), able to generate a data message (MD) from said release information of said particular zone (14A; 14B; 14C), the data message (MD) respecting a secure communication protocol, and to pass the data message (MD) to the communication board (61) so that it sends that data message (MD) over the communication network (22) to the interlocking system (19);

and wherein said sensor of the secondary detection system (SSD) a track circuit sensor or an axle sensor, said connector (57) and said application software (63) being adapted to the selected sensor; and

wherein said secure communication protocol is the protocol defined by standard $FSFB_2$.

2.- The equipment (20) according to claim 1, wherein said communication board (61) is a communication board of the ETHERNET type.

3.- The equipment (20) according to claims 1 or 2, wherein said pilot software (65) is able to command a reset of the release information for said particular zone (14A; 14B; 14C) from a reset message (MR) coming from said interlocking system (19) and received by said communication board (61).

4.- A signalization system for a railroad track (12), comprising:

- a communication network (22);

- an interlocking system (19) to control the travel of the vehicles (16) traveling on the railroad track (12); and

an automatic control architecture (10) for the railroad traffic on the track, the architecture being of the type based on control of the vehicles (16) by onboard computers (26), said railroad track (12) being subdivided into a plurality of zones (14A; 14B; 14C), said architecture comprising:

- a primary detection system (SPD), to detect the presence of a vehicle (16) on at least one particular zone (14A; 14B; 14C) from a determination of the position of the vehicle (16) done by a computer (26) onboard said vehicle (16), the primary detection system (SPD) being able to generate a first piece of release information; and

- a secondary track detection system (SSD), to detect the presence of a vehicle (16) on at least one particular zone (14A; 14B; 14C) of the track (12), comprising a sensor situated along the track, associated with said particular zone (14A; 14B; 14C) and able to generate a measurement signal, said secondary detection system (SSD) being able to generate a second piece of release information and communicate it to the interlocking system (19), the secondary detection system (SSD) being independent from the primary detection system (SPD),

wherein the secondary detection system (SSD) comprises a piece of equipment (20) according to any one of claims 1 to 4, the entry interface (55) of which is connected to said

at least one sensor (28A; 28B) and the communication board (61) of which is directly connected to the interlocking system, via the communication network (22).

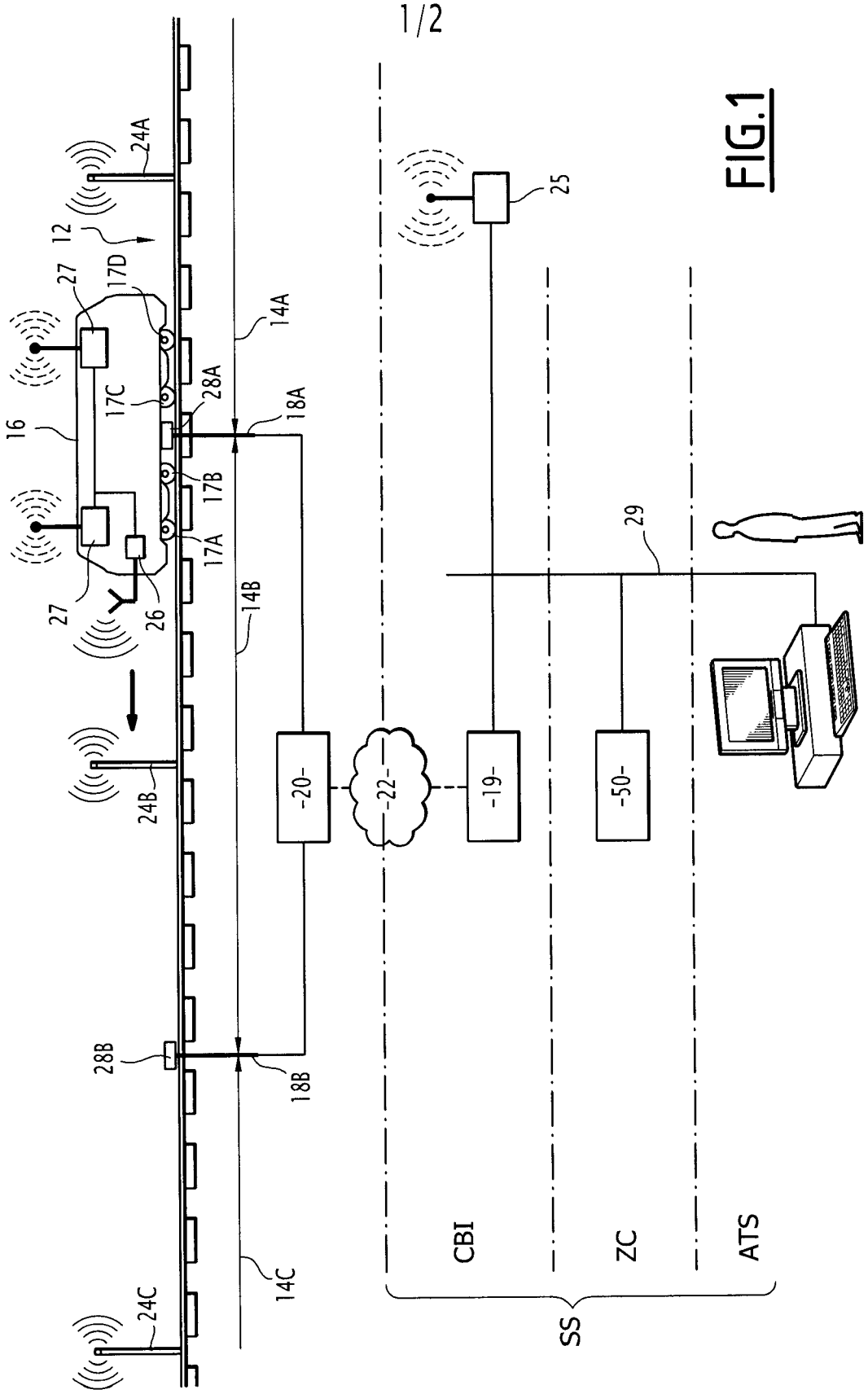

24A
12
27
17D
14A
17C
28A
18A
16
17B
17A
27
26
14B
24B
-20-
-22-
-19-
-50-
25
29
28B
18B
14C
24C
CBI
ZC
ATS
SS

FIG.1

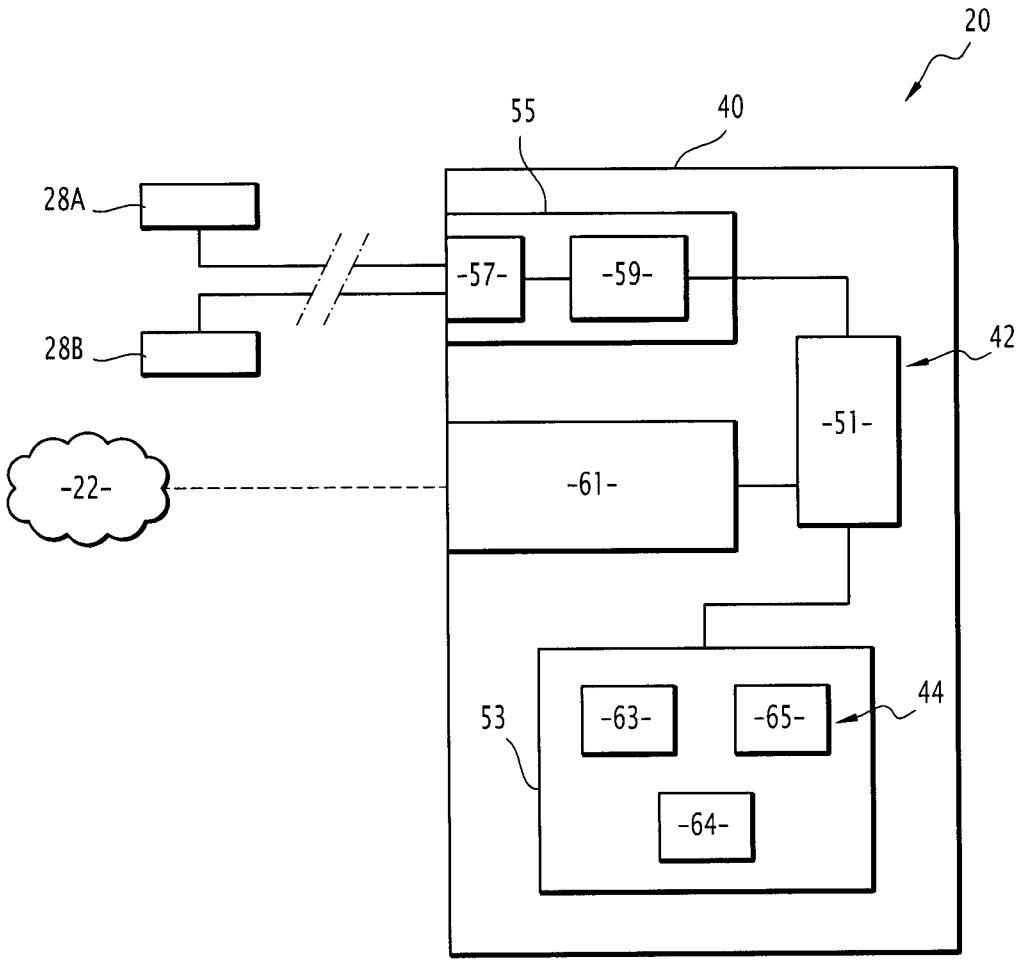
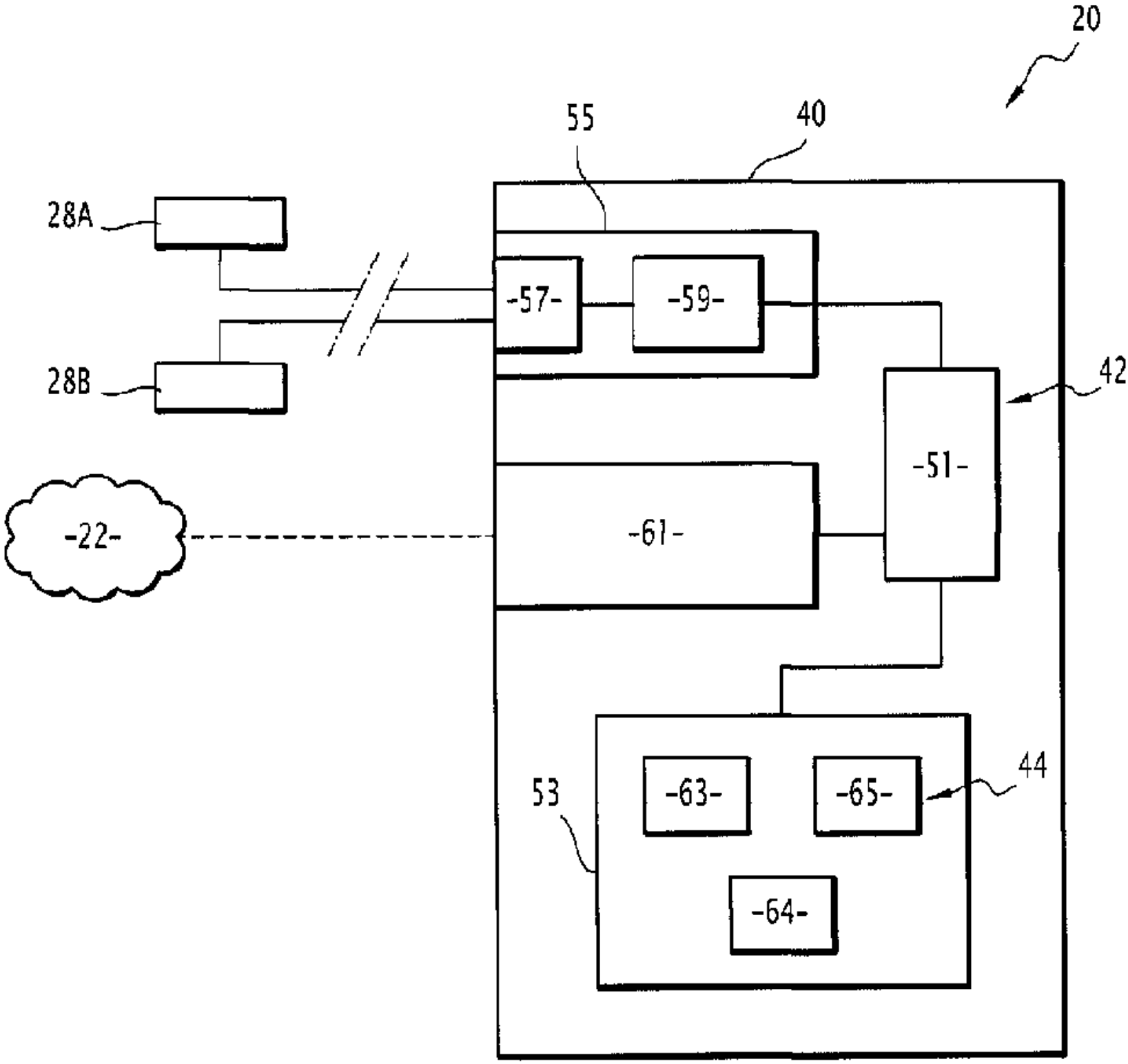


FIG.2


20
55
40
28A
28B
-57-
-59-
42
-51-
-22-
-61-
53
-63-
-65-
44
-64-