

**Method for discriminating the presence of a railway vehicle on a block,  
method for calculating and implementing a safety interval**

The present invention relates to a method for discriminating the presence of a railway vehicle on a block of a railway line.

By « discrimination of the presence of a railway vehicle on a block », is meant, in the sense of the present invention, the fact of determining whether said railway vehicle is the only vehicle occupying said block.

The invention applies to the field of railway safety, in particular to systems for automatic control of railway traffic. Such systems are for example, systems called « Communication Based Train Control » or CBTC.

For a railway vehicle circulating on a railway line, conventionally segmented into a plurality of successive blocks, an on-board computer of the vehicle computes an interval of positions of the vehicle on the railway track.

By « interval of positions » is meant, in the sense of the present invention, a segment of the railway track on which is found the railway vehicle.

The on-board computer determines the position of the vehicle along the railway track, for example from beacons positioned on the railway track, and the locations of which are known. More specifically, the on-board computer determines the interval of positions of the railway vehicle from the location of the last encountered beacon and from the displacement of the vehicle from this last beacon (this displacement for example being measured by an odometer) and by taking into account the length of the railway vehicle and safety distances on either sides of the head and tail ends of the railway vehicle.

The interval of positions of the vehicle is then sent, for example via radio waves, to a ground-based central computer. The ground-based computer is adapted for receiving the interval of positions associated with each vehicle from a plurality of railway vehicles allowed to circulate on the relevant track.

The ground-based computer is further able to receive information from so-called secondary detection devices, associated with each block of the railway track, each secondary detection device being able to determine whether the corresponding block is occupied or vacant.

By « occupied », is meant a block onto which the railway vehicle is at least partly engaged.

The ground-based computer is able to control the travel or the stopping of each vehicle depending on the interval of positions of the relevant vehicle, on the interval of

positions of each of the other vehicles, and on pieces of information received from the secondary detection devices, as well as optionally other operating constraints.

It is known how to achieve discrimination of the presence of a railway vehicle on a block according to the following method:

5           - the interval of positions of the vehicle is transmitted to the ground-based central computer;

          - for the block on which is entirely found the segment forming the interval of positions, if the distance between each end of the segment forming the interval of positions of the vehicle and the closest adjacent block is less than the length of the  
10       smallest vehicle allowed to move on the railway track, then the ground-based computer determines that said railway vehicle is the only vehicle occupying the relevant block.

Such a method is called « sweeping ».

Nevertheless, such a method does not give entire satisfaction.

Indeed, in the case when small size vehicles, such as maintenance vehicles (for  
15       which the length is generally of only a few meters), are allowed to circulate on the railway track, this method does not generally allow discrimination of the presence of a single railway vehicle on a block, since the distance between one end of the interval of positions of said vehicle and the closest adjacent block is often greater than the length of said maintenance vehicles.

20       In such a context, several options are provided to the operator of the railway network.

A first option consists of ignoring the small size vehicles in the traffic management system. Such a choice is obviously expressed by safety problems.

A second option consists of involving an operator for achieving the discrimination.  
25       Such an option therefore does not allow automatic operation of the railway network and may generate safety problems in the case of non-observance of the intervention procedures by the operator.

An object of the invention is therefore to propose a method for discriminating the presence of a railway vehicle on a block, which allows safe and automated operation of  
30       the railway network.

For this purpose, the object of the invention is a method of the aforementioned type, characterized in that it includes steps:

          - for transmitting from a computer on-board the railway vehicle to a ground-based computer, a piece of information relating to the number of axles of the railway vehicle;

- transmitting, over time by the sensors on the track associated with said block and with blocks adjacent to said block, towards a ground-based computer, a piece of information relating to the number of axles present in the corresponding block;

- discriminating with the ground computer the presence of said railway vehicle on said block if the number of axles present on said block is equal to the number of axles of said railway vehicle, and if the number of axles present on each of the blocks adjacent to said block is zero.

Indeed, with such a method, it is possible to determine without any ambiguity that if the number of axles present on the relevant block is equal to the number of axles of said railway vehicle, and that if the number of axles present on each of the blocks adjacent to said relevant block is zero, then said railway vehicle is actually the only vehicle present on the relevant block, and this regardless of the size of the smallest vehicle allowed to circulate on the railway network.

Further, such a method is entirely automatic and does not require the presence of an operator for carrying out the operation for discriminating the presence of said vehicle on the relevant block.

Further, the object of the invention is a method for computing a safety interval around a vehicle circulating on a railway track, the safety interval being formed by a segment having a front end and a rear end, the computing method being characterized in that it uses the discrimination method as defined above for discriminating the presence of the vehicle on a particular block, and it includes the additional steps of:

- identifying from the block(s) occupied by the railway vehicle, a front occupied block, which is the occupied block located the most downstream with respect to the direction of motion of the railway vehicle;

- identifying, from among the occupied block(s) by the railway vehicle, a rear occupied block, which is the occupied block located the most upstream with respect to the direction of motion of the railway vehicle;

- identifying a front vacant block, which is the vacant block located downstream from the front occupied block, adjacent to the front occupied block;

- identifying a rear vacant block, which is the vacant block located upstream from the rear occupied block, adjacent to the rear occupied block;

- assigning to the front end of the safety interval a point located on the front vacant block and which is found at a predetermined distance from the boundary between the front occupied block and the front vacant block;

- assigning to the rear end of the safety interval a point located on the rear vacant block and which is found at a predetermined distance from the boundary between the rear occupied block and the rear vacant block;

- transmitting, from the on-board computer to the ground computer, a piece of information relating to the position of the railway vehicle and to an interval of positions of the railway vehicle, the position of the railway vehicle being a segment comprised between the front and the rear of the railway vehicle, the interval of positions being a segment having a front end and a rear end, the position of the railway vehicle being included in said interval of positions;

- if the front and the rear of the railway vehicle, obtained from the position of the railway vehicle, are comprised within the limits of a same block, ascribing with the ground computer the interval of positions to the safety interval;

- otherwise, retaining the computed safety interval.

Further, the object of the invention is a device for discriminating the presence of a railway vehicle on a block of a railway track, characterized in that it includes:

- a ground-based computer;

- an on-board computer of the railway vehicle, able to transmit over time, towards the ground-based computer, a piece of information relating to the number of axles of the railway vehicle;

- sensors on the track associated with said block and with blocks adjacent to said block, able to transmit, over time, to the ground-based computer, a piece of information relating to the number of axles present in the corresponding block;

the ground-based computer being able to discriminate the presence of said railway vehicle if the number of axles present on the block is equal to the number of axles of the railway vehicle, and if the number of axles present on each of the blocks adjacent to said block is zero.

According to another advantageous aspect of the invention, the device includes the following feature:

- the ground-based computer is able to apply the computing method as defined above, for computing a safety interval.

The invention will be better understood by means of the description which follows, only given as a non-limiting example and made with reference to the appended drawings wherein:

- Figs. 1 to 3 are schematic illustrations of the successive steps of the discrimination method according to the invention, with a first initial situation; and

- Figs. 4 to 7 are schematic illustrations of the successive steps of the discrimination method according to the invention, with a second initial situation different from the first initial situation.

A railway vehicle 2 circulating on a railway track 4 is illustrated in Fig. 1. In the example, circulation on the track 4 is performed from left to right in the figures.

The discrimination of the position of the railway vehicle 2 is achieved by a discrimination device 5 including a ground-based component and an on-board component.

For the ground-based component, the railway track 4 is subdivided into a plurality of successive blocks 6. Each block 6 is identified by an identifier, which is associated with the geographic position of the block.

For example, the railway track 4 includes a first block 6A, a second block 6B, a third block 6C and a fourth block 6D.

Sensors on the track are positioned along the track for detecting the presence of a vehicle. The sensors on the track are of the axle counter type.

More specifically, the railway track 4 includes a plurality of sensors 7. A sensor 7 is positioned at the boundary between two adjacent blocks 6. For example, a first sensor 7A is positioned at the boundary between the blocks 6A and 6B, a second sensor 7B is positioned at the boundary between the blocks 6B and 6C, and a third sensor 7C is positioned at the boundary between the blocks 6C and 6D.

Each sensor 7 is able to detect the passage of an axle of a railway vehicle at the boundary between the corresponding blocks 6.

Further, a plurality of secondary detection devices 8 are positioned in proximity to the railway track 4.

Each block 6 is associated with a corresponding secondary detection device 8. In particular, and as this appears in the figures, the blocks 6B, 6C and 6D are respectively associated with the secondary detection devices 8B, 8C and 8D.

Each secondary detection device 8 is connected to two sensors 7 positioned at each of the ends of the corresponding block 6, in order to receive a piece of information relating to the detection of the passage of an axle of a railway vehicle from the corresponding block 6 to an adjacent block, or from an adjacent block to the corresponding block 6.

For example, the secondary detection device 8B is connected to the sensors 7A and 7B, and the secondary detection device 8C is connected to the sensors 7B and 7C.

Each secondary detection device 8 is able to determine the number of axles present on the corresponding block 6. In particular, each secondary detection device 8 is

able to determine the number of axles present on the corresponding block 6 from information provided by each of the corresponding sensors 7. Each secondary detection device 8 is able to positively count an axle detected by the sensor 7 positioned at the boundary between the block 6 corresponding to said secondary detection device 8 and the block 6 located upstream with respect to the circulation direction on the railway track 4, which corresponds to the situation when said axle engages into the block 6 corresponding to the secondary detection device 8.

Further, each secondary detection device 8 is able to negatively count an axle detected by the sensor 7 positioned at the boundary between the block 6 corresponding to said secondary detection device 8 and the block 6 located downstream with respect to the circulation direction on the railway track 4, which corresponds to the situation when said axle leaves the block 6 corresponding to said secondary detection device 8.

Each secondary detection device 8 is further connected to a ground-based computer 12, for example via a radio link. Each secondary detection device 8 transmits to the ground-based computer 12 a piece of information relating to the number of axles present on the corresponding block 6. Further, each secondary detection device 8 is able to transmit to the ground-based computer 12 the identifier of the corresponding block 6.

For the on-board component, a plurality of beacons 9 is positioned along the railway track 4. The beacons 9 are successively positioned along the railway track 4, at predetermined geographic locations. For example a beacon 9 is placed at the center of each block 6. Each beacon 9 is identified by a single beacon identifier.

The railway vehicle 2 includes at least one antenna associated with an on-board beacon sensor capable of detecting the presence of a beacon 9 when it is found in proximity to the latter and of capturing pieces of information relating to this detected beacon 9. Preferably, the beacon 9 is able to communicate its identifier to the beacon sensor of the railway vehicle 2.

The railway vehicle 2 also includes instruments for measuring the displacement, the speed and/or the acceleration of the railway vehicle 2. The measurement instruments are for example odometers and/or accelerometers.

Further, the railway vehicle 2 includes an on-board computer 14.

The computer 14 comprises a memory including a table associating with the identifier of each beacon 9 of the track 4, the position of this beacon 9 along the railway track 4.

The measurement instruments and the beacon sensor are connected to the on-board computer 14.

Conventionally, the on-board computer 14 is able to compute, from information received from the measurement instruments and from the beacon sensor, the position of the railway vehicle 2, as well as an interval of positions  $S_1$  of the railway vehicle 2.

The position of the railway vehicle 2 is given by the position of the front end of the railway vehicle 2, further called « front of the railway vehicle 2 », and by the position of the rear end of the railway vehicle 2, further called « rear of the railway vehicle 2 ». More specifically, the position of the railway vehicle 2 is the segment comprised between the front of the railway vehicle 2 and the rear of the railway vehicle 2. This segment corresponds to the length of the railway vehicle 2.

As illustrated by Fig. 2, the interval of positions  $S_1$  corresponds to a segment extending between a front end  $A_1$  and a rear end  $Z_1$ . The length of the segment  $S_1$  is greater than or equal to the length of the railway vehicle 2, in order to take into account localization errors, for example due to the odometric system of the railway vehicle 2. The railway vehicle 2 is thus always found in the interval  $S_1$ , or said otherwise, the position of the railway vehicle 2 is always comprised in the interval of positions  $S_1$ .

The front of the railway vehicle 2 and the front end  $A_1$  of the interval  $S_1$  are distant by a distance  $D_A$ . Further, the rear of the railway vehicle 2 and the rear end  $Z_1$  of the interval  $S_1$  are distant by a distance  $D_Z$ .

The distance  $D_A$  is for example equal to the maximum distance which may cover the railway vehicle 2 forwards during a cycle for computing the interval  $S_1$  by the on-board computer 14, given the current speed of the railway vehicle 2 and the maximum forward acceleration which said railway vehicle 2 may attain. In the example described below, the current speed is zero.

Further, the distance  $D_Z$  is for example equal to the maximum distance which the railway vehicle 2 may cover backwards during a cycle for calculating the interval  $S_1$  by the on-board computer 14, given the current speed of the railway vehicle 2 and the maximum backward acceleration which said railway vehicle 2 may attain. In the example described below, the current speed is zero.

Thus, between two successive computing cycles, the railway vehicle 2 never leaves the interval of positions  $S_1$ .

The on-board computer 14 is able to communicate with the ground-based computer 12. The on-board computer 14 and the ground-based computer 12 are for example able to communicate with each other via radio waves.

The on-board computer 14 is able to transmit, to the ground-based computer 12, a piece of information relating to the number of axles of the railway vehicle 2. This

information is loaded into the memory of the computer 14 during the composition of the railway vehicle 2.

The on-board computer 14 is also able to transmit, to the ground-based computer 12, the last interval of positions  $S_1$  of the railway vehicle 2 computed by the on-board computer 14. The on-board computer 14 is also able to transmit, to the ground-based computer 12, the last computed position of the railway vehicle 2 by the on-board computer 14.

The ground-based computer 12 includes a memory (not shown) wherein the identifier of each block 6 is associated with the geographic position of said block 6.

The ground computer 12 is able to compute an interval of positions of the railway vehicle 2, a so-called « secondary interval »  $S_2$ , from information received from the secondary detection devices 8.

As illustrated in Fig. 1, the secondary interval  $S_2$  corresponds to a segment of front end  $A_2$  and of rear end  $Z_2$ . By design, and as this will be described subsequently, the length of the secondary interval  $S_2$  is greater than or equal to the length of the interval  $S_1$ , so that the interval  $S_1$  is always included in the secondary interval  $S_2$ .

The front end  $A_2$  of the secondary interval  $S_2$  is located in front of the railway vehicle 2, more specifically in a point of a block 6 which is the first front vacant block, i.e. from the front of the railway vehicle 2, in the direction of motion of the railway vehicle 2.

The front end  $A_2$  is located at a distance  $L_A$  from the boundary between this first front vacant block and the adjacent block which is occupied by the railway vehicle 2.

The distance  $L_A$  is for example equal to the distance between the front of the railway vehicle 2 and the axle of the railway vehicle closest to the front of the railway vehicle, to which is added the distance which the railway vehicle 2 may cover at its maximum forward speed, during the maximum time required for the discrimination device 5 for detecting the entry of an axle in a block 6. Preferably, the distance  $L_A$  is greater than or equal to the distance  $D_A$ .

The rear end  $Z_2$  of the secondary interval  $S_2$  is located behind the railway vehicle 2, more particularly in a point of a block which is the first rear vacant block 6, i.e. from the rear of the railway vehicle 2, in the opposite direction to the motion of the railway vehicle 2.

The rear end  $Z_2$  is located at a distance  $L_Z$  from the boundary between this first rear vacant block and the adjacent block which is occupied by the railway vehicle.

Further, the distance  $L_Z$  is for example equal to the distance between the rear of the railway vehicle 2 and the axle of the railway vehicle closest to the rear of the vehicle 2, to which is added the distance which the railway vehicle 2 may cover at its maximum

speed backwards, during the maximum time required for the discrimination device 5 for detecting the entry of an axle into a block 6. Preferably, the distance  $L_z$  is greater than or equal to the distance  $D_z$ .

The localization device 5 is able to discriminate the presence of the railway vehicle 2 on the block 6 which it occupies depending on the data transmitted by the secondary detection devices 8 and by the on-board computer 14.

The operation of the localization device 5 will now be described. In particular, the operation of the localization device 5 when the railway vehicle 2 is at a standstill, for example after a waking period, will be described.

All along the method for discriminating the railway vehicle 2 on the blocks 6 of the railway track 4, the on-board computer 14 periodically transmits to the ground-based computer 12, pieces of information relating to the total number of axles of said railway vehicle 2. Further, all along said method, the on-board computer 14 periodically computes the interval of positions  $S_1$  and the position of the railway vehicle 2 and transmits them to the ground-based computer 12.

According to a first example, illustrated by Figs. 1 to 3, the railway vehicle 2 is immobile and occupies a single block 6B, i.e. neither the front, nor the rear of the railway vehicle 2 exceed the limits of the current block 6B. Further, the adjacent blocks 6A and 6C are vacant.

During an initial step of the discrimination method, illustrated by Fig. 1, the detection devices 8 send to the ground-based computer 12 pieces of information relating to the occupation of the blocks 6 of the railway track 4. More specifically, the detection devices 8 send the number of axles present on each of the corresponding blocks 6. Here, the blocks 6A and 6C are vacant, i.e. they are not occupied by any axle. Further, only the block 6B is occupied by at least one vehicle. In this case, four axles are present on the block 6B.

The ground-based computer 12 identifies the vacant blocks and then computes the position of the ends  $A_2$ ,  $Z_2$  of the secondary interval  $S_2$ .

The front end  $A_2$  of the secondary interval  $S_2$  is located on the block 6C, at a distance  $L_A$  from the boundary between the block 6B and the block 6C.

The rear end  $Z_2$  of the secondary interval  $S_2$  is located on the block 6A, at a distance  $L_z$  from the boundary between the block 6B and the block 6A.

And then the ground-based computer 12 assigns the secondary interval  $S_2$  to the position of the railway vehicle(s) present on the block 6B. Indeed, at this moment of the method, the railway vehicle 2 has not yet been discriminated. The number of vehicles present on the block 6B is therefore not known.

During a next step, illustrated by fig. 2, the on-board computer 14 computes the position of the railway vehicle 2, as well as the interval of positions  $S_1$ . The on-board computer 14 then transmits to the ground-based computer 12, information relating to the position of the railway vehicle 2, as well as to the interval of positions  $S_1$ .

5 The on-board computer 14 further transmits to the ground-based computer 12, the number of axles of the railway vehicle 2, in this case four axles.

The front and the rear of the railway vehicle 2, obtained from the position of the railway vehicle 2 computed by the on-board computer 14, are contained in the current block 6B; further, the number of axles detected by the secondary detection device 8  
10 associated with the current block 6B is equal to the number of axles of the railway vehicle 2. Therefore, during a subsequent step illustrated by Fig. 3, the ground-based computer 12 determines that the railway vehicle 2 is the only vehicle occupying the block 6B.

The ground-based computer 12 only retains the interval of positions  $S_1$  and assigns it to the secondary interval  $S_2$  for regulation of traffic on the railway track 4.

15 The ground-based computer 12 considers that the railway vehicle 2 is the only vehicle present on the block 6B. The ground-based computer 12 then transmits a discrimination signal, for example intended for an operator or a railway traffic management system.

The railway vehicle 2 is then allowed to move automatically.

20 According to a second example, illustrated by Figs. 4 to 7, the railway vehicle 2 is immobile and occupies two adjacent blocks 6B and 6C. In this case, the front of the railway vehicle 2 is found in the block 6C, and the rear of the railway vehicle 2 is found in the block 6B. Such an example corresponds to a degraded operating mode.

Further, the adjacent blocks 6A and 6D are vacant, the devices 8A and 8D  
25 respectively count 0 axles on the associated block.

During an initial step of the discrimination method, illustrated by Fig. 4, the detection devices 8 send to the ground-based computer 12 information relating to the occupation of the corresponding blocks 6 of the railway track 4. More specifically, the detection devices 8 send the number of axles present on each of the corresponding  
30 blocks 6. Here, blocks 6A and 6D are vacant, and blocks 6B and 6C are occupied by at least one vehicle. In this case, the secondary detection device 8B, associated with the block 6B, detects three axles present on the block 6B. Further, the secondary detection device 8C associated with the block 6C detects one axle present on the block 6C.

35 The ground-based computer 12 identifies the vacant blocks and then computes the position of the ends  $A_2$ ,  $Z_2$  of the secondary interval  $S_2$ .

The front end  $A_2$  of the secondary interval  $S_2$  is located on the block 6D, at a distance  $L_A$  from the boundary between the block 6C and the block 6D.

The rear end  $Z_2$  of the secondary interval  $S_2$  is located on the block 6A, at a distance  $L_Z$  from the boundary between the block 6B and the block 6A.

5 And then the ground-based computer 12 assigns the secondary interval  $S_2$  to the position of the railway vehicle(s) present on the blocks 6B and 6C. Indeed, at this instant of the method, the railway vehicle 2 has not yet been discriminated. The number of vehicles present on the blocks 6B and 6C is therefore not known.

10 During a subsequent step, illustrated by Fig. 5, the on-board computer 14 computes the position of the railway vehicle 2, as well as the interval of positions  $S_1$ . The on-board computer 14 then transmits, to the ground-based computer 12, information relating to the position of the railway vehicle 2, as well as to the interval of positions  $S_1$ .

The front and the rear of the railway vehicle 2 being located in two distinct blocks 6B, 6C, the ground-based computer 12 is unable to discriminate the railway vehicle 2.

15 Thus, during a subsequent step, illustrated by Fig. 6, an operator maneuvers the railway vehicle 2 to make it progress along the railway track 4, until the front and the rear of the railway vehicle 2 are located in the same block 6, in this case, the block 6C. For example, the operator visually maneuvers the railway vehicle 2.

20 When the position of the railway vehicle 2 is such that the front and the rear of the railway vehicle 2 are found in the same block 6C, the secondary detection device 8C associated with the block 6C detects four axles present on the block 6C, while the secondary detection device 8B associated with the block 6B does not detect any axle. Further, the secondary detection device 8D associated with the block 6D also does not detect any axle on the block 6D.

25 The ground-based computer 12 then again computes a new position of the ends  $A_2$ ,  $Z_2$  of the secondary interval  $S_2$ .

The front end  $A_2$  of the secondary interval  $S_2$  is located on the block 6D, at a distance  $L_A$  from the limit between the block 6C and the block 6D.

30 The rear end  $Z_2$  of the secondary interval  $S_2$  is located on the block 6B, at a distance  $L_Z$  from the limit between the block 6C and the block 6B.

The ground-based computer 12 is then able to discriminate the railway vehicle 2, similarly to the previous example.

35 More specifically, during a subsequent step, illustrated by Fig. 7, the ground-based computer 12 compares the number of axles detected by the secondary detection device 8 associated with the current block 6C with the number of axles of the railway vehicle 2.

The secondary detection device 8C associated with the block 6C detects four axles present on the block 6C, while the secondary detection devices 8B, 8D associated with the blocks 6B, 6D respectively do not detect any axle.

5 As the blocks 6B and 6D are vacant, and the number of axles detected by the secondary detection device 8 associated with the current block 6C is equal to the number of axles of the railway vehicle 2, i.e. four axles, the ground-based computer 12 determines that the railway vehicle 2 is the only vehicle occupying the block 6C.

The ground-based computer 12 only retains the interval of positions  $S_1$  and assigns it to the secondary interval  $S_2$  for the regulation of the traffic on the railway track 4.

10 The ground-based computer 12 considers that the railway vehicle 2 is the only vehicle present on the block 6C. The ground-based computer 12 then transmits a discrimination signal, for example to an operator or to a railway traffic management system.

The railway vehicle 2 is then allowed to move automatically.

15 During the operation of the discrimination device 5, the secondary interval  $S_2$  corresponds to a safety interval from the point of view of a railway traffic management system, based on the ground. The construction of the secondary interval  $S_2$  guarantees, with a high safety level, for example level 4 of the SIL standard commonly used in the railway field, the absence of a vehicle in the blocks 6 which are not covered by the  
20 secondary interval  $S_2$ .

In the case of a railway convoy consisting of at least two railway vehicles attached to each other, the computer 14 on-board of each of the railway vehicles of the railway convoy transmits a piece of information relating to the number of axles of the corresponding railway vehicle to the ground-based computer 12.

25 Alternatively, a single onboard computer transmits a piece of information relating to the number of axles of the whole of the railway convoy to the ground-based computer 12.

CLAIMS

1.- A method for computing a safety interval ( $S_2$ ) around a vehicle circulating on a railway track (4), the safety interval ( $S_2$ ) being formed by a segment having a front end ( $A_2$ ) and a rear end ( $Z_2$ ), the computing method being characterized in that it uses a method for discriminating the presence of a railway vehicle (2) on a block (6B; 6C) of the railway track (4), including the steps of:

- transmitting, from a computer (14) on-board the railway vehicle (2) to a ground-based computer (12), a piece of information relative to the number of axles of the railway vehicle (2);

- transmitting, over time, by sensors on the track (8B; 8C) associated with said block (6B; 6C) and with blocks (6A, 6C; 6B, 6D) adjacent to said block (6B; 6C), to a ground-based computer (12), a piece of information relating to the number of axles present in the corresponding block (6A, 6B, 6C, 6D);

- discriminating with the ground-based computer (12) the presence of said railway vehicle (2) on said block (6C) if the number of axles present on said block (6B; 6C) is equal to the number of axles of said railway vehicle (2), and if the number of axles present on each of the blocks (6A, 6C; 6B, 6D) adjacent to said block (6B; 6C) is zero,

and that it includes the additional steps of:

- identifying from among the block(s) (6B; 6B, 6C; 6C) occupied by the railway vehicle (2), a front occupied block (6B; 6C; 6C), which is the occupied block (6B; 6B, 6C; 6C) located the most downstream with respect to the direction of motion of the railway vehicle (2);

- identifying, from among the block(s) (6B; 6B, 6C; 6C) occupied by the railway vehicle (2), a rear occupied block (6B; 6B; 6C), which is the occupied block (6B; 6B, 6C; 6C) located the most upstream with respect to the direction of motion of the railway vehicle (2);

- identifying a front vacant block (6C; 6D; 6D), which is the vacant block (6) located downstream from the front occupied block (6B; 6C; 6C), adjacent to the front occupied block (6B; 6C; 6C);

- identifying a rear vacant block (6A; 6A; 6B), which is the vacant block (6) located upstream from the rear occupied block (6B; 6B; 6C), adjacent to the rear occupied block (6B; 6B; 6C);

- assigning to the front end ( $A_2$ ) of the safety interval ( $S_2$ ) of a point located on the front vacant block (6C; 6D; 6D) and which is found at a predetermined distance ( $L_A$ ) from

the boundary between the front occupied block (6B; 6C; 6C) and the front vacant block (6C; 6D; 6D) ;

5       - assigning to the rear end ( $Z_2$ ) of the safety interval ( $S_2$ ) a point located on the rear vacant block (6A; 6A; 6B) and which is found at a predetermined distance ( $L_z$ ) from the boundary between the rear occupied block (6B; 6B; 6C) and the rear vacant block (6A; 6A; 6B) ;

10       - transmitting from the on-board computer (14) to the ground-based computer (12), a piece of information relating to the position of the railway vehicle (2) and to an interval of positions ( $S_1$ ) of the railway vehicle (2), the position of the railway vehicle (2) being a segment comprised between the front and the rear of the railway vehicle (2), the interval of positions ( $S_1$ ) being a segment having a front end ( $A_1$ ) and a rear end ( $Z_1$ ), the position of the railway vehicle (2) being included in said interval of positions ( $S_1$ ) ;

15       - if the front and the rear of the railway vehicle (2), obtained from the position of the railway vehicle (2), are comprised in the limits of a same block (6B; 6C), assigning with the ground-based computer (12) the interval of positions ( $S_1$ ) to the safety interval ( $S_2$ );

      - otherwise retaining the computed safety interval ( $S_2$ ).

2.- A device (5) for discriminating the presence of a railway vehicle (2) on a block (6C) of a railway track (4), characterized in that it includes:

20       - a ground-based computer (12) able to apply the computing method according to claim 1 for computing a safety interval ( $S_2$ ) ;

      - a computer (14) onboard the railway vehicle (2), able to transmit over time, to the ground-based computer (12), a piece of information relating to the number of axles of the railway vehicle (2) ;

25       - sensors on the track (8) associated with said block (6C) and with blocks (6B, 6D) adjacent to said block (6C), able to transmit over time to the ground-based computer (12), a piece of information relating to the number of axles present in the corresponding block (6B, 6C, 6D);

30       the ground-based computer (12) being able to discriminate the presence of said railway vehicle (2) if the number of axles present on the block (6C) is equal to the number of axles of the railway vehicle (2), and if the number of axles present on each of the blocks (6B, 6D) adjacent to said block (6C) is zero.