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(54) TRAIN COUPLING SUPPORT SYSTEM

(57) A support system for supporting a coupling operation between a first train unit and a second train unit is provided. Each train unit has a respective coupler for coupling to the coupler of the other train unit, and a respective coupler cover which is movable between a closed configuration in which the cover covers its coupler and an open configuration in which the coupler is revealed to allow coupling. The support system includes a distance measuring device mountable at a front of the first train unit and operable to measure a distance between the first train unit and the second train unit. The support system further includes a coupler cover monitoring device mountable to the first train unit and operable to detect an open or closed configuration status of the first train unit's coupler cover. The support system further includes a protection sub-system mountable to the first train unit. The protection sub-system receives a distance measurement from the distance measuring device and a configuration status from the coupler cover monitoring device, and issues a coupling stop signal when the distance measurement is less than a predetermined threshold distance and the configuration status indicates the first train unit's coupler cover is closed.

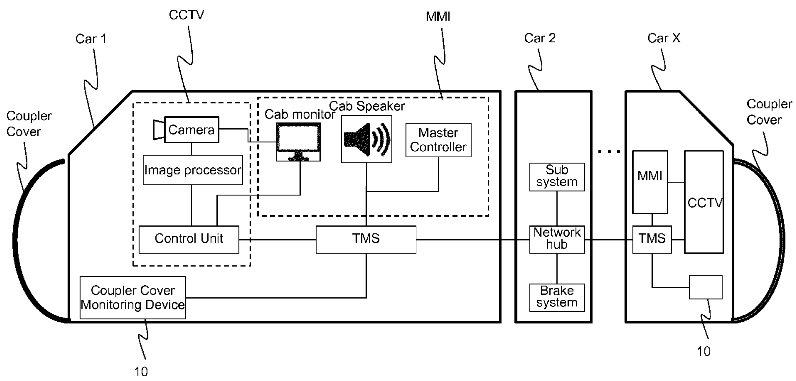

Fig. 1

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Description

Field of the Present Disclosure

[0001] The present disclosure relates to a support system for supporting a coupling operation between a first train unit and a second train unit.

Background

[0002] Generally, high speed and medium speed trains are provided with end car coupler covers which have a closed configuration to improve the aerodynamics of the end car, and an open configuration in which a coupler is revealed to allow coupling of the end car to another end car.

[0003] In a coupling operation, the driver of one train unit drives that unit slowly toward the other, stationary, train unit. During this operation, the driver visually checks that the coupler cover of the stationary unit is open. If the open or closed status of the coupler cover of the driven unit is not visible from the driver's cab, track-side personnel may provide confirmation of its open configuration status during the operation.

[0004] Evidently, it is important to avoid a situation in which the train units are brought together with either or both coupler covers closed. The checking of the coupler cover configuration status relies on the visual checking performed by the driver and sometimes also the track-side personnel. In the event this visual check is not performed correctly, there is a risk that a coupler cover will be damaged/broken. The train unit cannot then be used for service operation until the cover is repaired, which negatively impacts on transportation services.

[0005] The present disclosure addresses these issues, and especially seeks to avoid a situation train units are coupled in error with closed coupler covers.

Summary

[0006] A first aspect of the present disclosure provides a support system for supporting a coupling operation between a first train unit and a second train unit, each train unit having a respective coupler for coupling to the coupler of the other train unit, and a respective coupler cover which is movable between a closed configuration in which the cover covers its coupler and an open configuration in which the coupler is revealed to allow coupling, the support system including:

a distance measuring device mountable at a front of the first train unit and operable to measure a distance between the first train unit and the second train unit;
a coupler cover monitoring device mountable to the first train unit and operable to detect an open or closed configuration status of the first train unit's coupler cover; and
a protection sub-system mountable to the first train unit, the protection sub-system receiving a distance measurement from the distance measuring device and a configuration status from the coupler cover monitoring device, and issuing a coupling stop signal when the distance measurement is less than a predetermined threshold distance and the configuration status indicates the first train unit's coupler cover is closed.

[0007] Advantageously, by combining in this way the distance measurement with the coupler cover configuration status it is possible to reduce the risk of damage to the first train unit's coupler cover even if the driver or track-side personnel perform the visual check of the coupler cover configuration status incorrectly.

[0008] A second aspect of the present disclosure provides a train unit having:

a coupler for coupling to the coupler of another train unit;
a coupler cover which is movable between a closed configuration in which the cover covers the coupler and an open configuration in which the coupler is revealed to allow coupling; and
the support system of the first aspect mounted thereto for supporting a coupling operation between the train unit and the other train unit.

[0009] Optional features of the present disclosure will now be set out. These are applicable singly or in any combination with any aspect of the present disclosure.

[0010] The support system may further include a driver alert sub-system connected to the protection sub-system, the driver alert sub-system issuing a warning to a driver of the first train unit on receipt of the coupling stop signal. For example, the driver alert sub-system can include a speaker which issues an audible warning signal and/or visual warning signal e.g. in the form of a warning light or a message on a screen monitor.

[0011] The support system may further include a brake sub-system connected to the protection sub-system, the brake sub-system applying brakes of the first train unit on receipt of the coupling stop signal.

[0012] The distance measuring device may comprise a camera which obtains an image of the front of the second train unit, and an image processing unit which determines the distance between the first train unit and the second train unit from the obtained image. For example, the image processing unit may also determine the open or closed configuration status of the coupler cover of the second train unit from the obtained image, and the protection sub-system also issues the coupling stop signal when the distance measurement is less than a predetermined threshold distance and the image processing unit determines the second train unit's coupler cover is closed. In this way, the protection afforded by the support system can be extended to the second train unit.

[0013] The support system may have one or more means for reducing the probability of false positive coupling stop signal being issued. For example, the protection sub-system may receive a signal indicating whether a traction sub-system of the train unit is operating or not operating, and then may only the issue the coupling stop signal when the traction sub-system is operating. As another example, the protection sub-system may receive a signal indicating whether brakes of the train unit are on or off, and then may only the issue the coupling stop signal when the brakes are off. And as another example, the protection sub-system may receive a signal indicating a running direction of a train of which the train unit is a component, and then may only the issue the coupling stop signal when the train running direction indicates that the first train unit is a head unit of the train.

Brief Description of the Drawings

[0014] Embodiments of the present disclosure will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 shows schematically a first embodiment of a coupling support system installed on a train unit;

Figure 2 shows examples of camera images taken by a front camera used to measure the distance between a train unit and another train;

Figure 3 shows schematically an example logic structure for sending a coupling stop signal in the form of an alarm signal from a Train Monitoring System (TMS) to a Cab Speaker, and a brake command signal to a brake sub-system;

Figure 4 shows schematically a variant logic structure in which an alarm signal is sent from a CCTV to a Cab Monitor;

Figure 5 shows schematically a second embodiment of a coupling support system installed on a train unit;

Figure 6 shows schematically an example logic structure for sending a coupling stop signal in the form of an alarm signal to the Cab Speaker and a brake command signal to the brake sub-system;

Figure 7 shows schematically a variant logic structure in which an alarm signal is sent from the CCTV to the Cab Monitor;

Figure 8 shows schematically a third embodiment of a coupling support system installed on a train unit;

Figure 9 shows schematically an example logic structure for sending a coupling stop signal in the form of an alarm signal from the TMS to the Cab Speaker and the Cab Monitor, and a brake command signal to the brake sub-system;

Figure 10 shows schematically another example logic structure for the case when the CCTV has the ability to detect the coupler cover configuration of an opposing train by using a camera image from a front camera;

Figure 11 shows schematically a fourth embodiment of a coupling support system installed on a train unit;

Figure 12 shows schematically an example logic structure for sending a coupling stop signal in the form of an alarm signal from the CU to the Cab Speaker and the Cab Monitor; and

Figure 13 shows schematically another example logic structure for the case when the CCTV has the ability to detect the coupler cover configuration of an opposing train by using a camera image from a front camera.

Detailed Description and Further Optional Features

[0015] Figures 1 to 4 relate to a first embodiment of a coupling support system for supporting a coupling operation between a first train unit and a second train unit.

[0016] Figure 1 shows schematically an example of the coupling support system. In this example, the first train unit is one of the end units (Car 1) of a multi-car train (having Cars 1 to X). The other end unit (Car X) of the train has a similar coupling support system. Each of the end units has a respective coupler and a respective coupler cover which is movable between a closed configuration in which the cover covers its coupler and an open configuration in which the coupler is revealed to allow coupling. The support system comprises the following sub-systems and devices:

- Train Monitoring System (TMS): The TMS is connected with a brake sub-system and other sub-systems (doors, traction system etc.) via a communication network. It transfers control signals to the brake sub-system and the other sub-systems, and detects statuses of the brake sub-system and the other sub-systems.

- Coupler Cover Monitoring Device: The Coupler Cover Monitoring Device 10 detects the opened or closed configuration status of the coupler cover. For example, the Coupler Cover Monitoring Device 10 can include one or more limit switches. The, or each, limit switch has an arm coupled to the coupler cover. Moving the coupler cover between its open and closed configurations operates the arm such that the limit switch is moved between corresponding ON and OFF states. The limit switch therefore detects the open or closed configuration status of the coupler cover on the basis of this state.

- Man-Machine Interface (MMI): The MMI includes Cab Speakers and Cab Monitors which respectively output audible and visual warnings to the train unit driver. A Master Controller used by the driver of the train unit for controlling the train can include a driver key receiver for use in detecting the running direction of the train.

- Closed-Circuit Television (CCTV): The CCTV includes one or more Front Cameras taking forward images from the train unit, an Image Processor which processes images taken by the Front Cameras, and a Control Unit (CU) for controlling the CCTV and interfacing with the TMS and the MMI.

[0017] The TMS is connected with the MMIs in both end units (Car 1, Car X) though the communication network. For example, the driver needs to present the driver key to the Master Controller of one of the MMIs when he/she starts the train. The TMS then receives notice from that Master Controller that a key has been received by its driver key receiver, and determines the train running direction based on the train unit location of the Master Controller. Therefore, when the driver key is received by the Master Controller of Car 1 the direction from Car X to Car 1 is determined as being the running direction, and when the driver key is received by the Master Controller of Car X the direction from Car 1 to Car X is determined as being the running direction.

[0018] If the Master Controller has an input switch which is moveable between "Forward" and "Backward" positions, the TMS can detect the running direction based on this inputted information. Therefore, when "Forward" is inputted form the Master Controller of Car 1, the direction from Car X to Car 1 is determined as being the running direction, and when "Backward" is inputted from the Master Controller of Car 1, the direction from Car 1 to Car X is determined as being the running direction. Alternatively, when "Forward" is inputted form the Master Controller of Car X, the direction from Car 1 to Car X is determined as being the running direction, and when "Backward" is inputted form the Master Controller of Car X, the direction from Car 1 to Car X is determined as being the running direction.

[0019] During a coupling operation, the head unit of one train (Car 1 in this example) is driven towards a stationary end unit of another train. The coupling support system on the driven unit is used for coupling support.

[0020] For example, the Cab Speaker of the MMI can be connected with the TMS through the communication network. In contrast, the Cab Monitor of the MMI, which displays to the driver images, such as one or more front image taken by the front cameras etc., can be connected with the CU of the CCTV through the communication network. Therefore, the information for the Cab Speaker is transferred from the TMS, and the information for the Cab Monitor is transferred from the CU of the CCTV. Although, the information for the Cab Speaker and the Cab Monitor are sent from different sub-systems, the coupling support system as a whole can provide visual and sound alarms at effectively the same time, because the TMS and the CU of the CCTV are synchronized with each other over a short time cycle, as discussed in more detail below. In addition, the TMS can output a brake command to the brake sub-system through the communication network to stop movement of the train.

[0021] For synchronisation of the TMS and the CCTV, the TMS transfers Train Status Information (TSI) over the short time cycle (e.g. every 200 millisecond) to the CU. The TSI includes information such as: the train configuration, train unit identification, status of the driver key, clock time of the TMS, running speed of the train, location of the train (e.g. detected by GPS or other means), and open/closed configuration status of the coupler cover. When the CU receives the TSI, the CU transfers System Status Information (SSI) of systems managed by the CCTV, such as the front cameras, as a response signal against the train status information (TSI). Thus this response signal is also transferred every 200 millisecond. The open/closed configuration status provided by the coupler cover monitoring device 10 can be used for alarm processing by the TMS and/or by the CCTV. In particular, when the driver key is received by the MMI of Car 1, the TMS and/or the CU uses the open/closed configuration status received from the coupler cover monitoring device 10 of Car 1 to perform alarm processing for the MMI of Car 1, and optionally also to perform brake command processing for the brake sub-system.

[0022] The front camera continuously transfers camera images to the Image Processor while the train unit is energized. The Image Processor stores head shape data of an end car in its memory, and compares this head shape data with image data captured by the front camera for determining whether another train is in front of the train unit. Thus when there is a match between the stored head shape data and the front camera image data the Image Processor detects that another train is in front the train unit, and when there is no match the Image Processor detects no such train in front of the train unit. On detection by the Image Processor of another train, the Image Processor then measures the distance between the train unit and the other train based on camera image data received from the front camera. The Image Processor transfers this measured distance information to the CU in real time.

[0023] Figure 2 shows an example of how camera images taken by the front camera can be used to measure the distance between the train unit and the other train. Figure 2 shows at left a camera image when the inter-train distance is relatively far, and at right a camera image when the inter-train distance is relatively short. The Image Processor processes the camera images taken by the front camera to detect two predetermined characteristic locations on the other train, and then measures the spacing between the characteristic locations. For example, if opposing side edges of the front windscreen of the other train are the characteristic locations, the Image Processor measures the spacing between these side edges on the camera image. The Image Processor stores in memory a look-up table that relates inter-train train distance to spacing of the windscreen side edges. The Image processor can thus measure the inter-train distance by reference to the look-up table.

[0024] The CCTV and the TMS together form a protection sub-system of the coupling support system, the protection sub-system receiving the inter-train distance measured by the Image Processor and a configuration status from the coupler cover monitoring device 10, and issuing a coupling stop signal when the measured distance is less than a predetermined threshold distance and the configuration status indicates the first train unit's coupler cover is closed. More particularly, Figure 3 shows schematically an example logic structure for sending an alarm signal from the TMS to the Cab Speaker, and for sending a brake command signal to the brake sub-system. If the inter-train distance becomes less than a predetermined value, the CU of the CCTV includes an alarm flag with the SSI. The TMS has an AND login circuit 101, and when this flag is received by the circuit and the coupler cover monitoring device 10 detects that the coupler cover is closed, the TMS sends the coupling stop signal in the form of an alarm signal to the Cab Speaker and a brake command signal to the brake sub-system via the communication network.

[0025] The AND logic circuit 101 is used instead of an OR circuit in order to reduce the likelihood that the Cab Speaker outputs unnecessary alarms, and thereby unnecessarily distracting the driver. For example, an alarm is not needed when the inter-train distance is far enough, even if the coupler cover is closed.

[0026] Optionally, as shown in Figure 3, a traction status signal indicating whether the train unit is moving can be added as an input to the AND logic circuit 101. For example, a traction ON signal received from the traction sub-system or a brake OFF signal received from the brake sub-system can also be inputted to the AND logic circuit 101. By including the traction status signal, the likelihood of unnecessary alarms (in particular when the train is started but is not ready to move) can be further reduced.

[0027] Figure 4 shows schematically a variant logic structure in which an alarm signal is sent from the CCTV to the Cab Monitor. When the coupler cover monitoring device 10 detects that the cover is closed, the TMS includes an alarm flag in the TSI. Optionally, a traction status signal indicating whether the train unit is moving can be used to decide whether the TMS should include the alarm flag in the TSI. In this case, the TMS can have an AND logic circuit 102 which receives the cover configuration status and the traction status signal.

[0028] The CCTV has an AND logic circuit 103 which sends an alarm signal to the Cab monitor when the alarm flag is included in the TSI from the TMS, and the inter-train distance measured by the Image Processor is less than a predetermined threshold value. The inter-train distance can be displayed on the Cab Monitor in real time, which helps the driver to confirm the distance objectively.

[0029] Figures 5 to 7 relate to a second embodiment of a coupling support system.

[0030] The second embodiment is similar to the first embodiment, except that the CCTV has an ability to detect the coupler cover configuration status of the other train by using the camera image from the front camera.

[0031] The Image Processor stores camera images of train head shapes when another opposing train's coupler cover is open and/or closed. Figure 5 shows schematically at left a front camera image when the coupler cover of the other train is open, and at right when it is closed. The Image Processor can thus detect the coupler cover configuration status of the other train by matching the stored head shape image with camera image received from the front camera. For example, the Image Processor can detect that a coupler cover is open if a stored camera image with the cover open matches a received camera image, whereas if there is no match the coupler cover is detected as closed. As another example, the Image Processor can detect that a coupler cover is closed if a stored camera image with the cover closed matches a received camera image, whereas if there is no match the coupler cover is detected as open.

[0032] Figure 6 shows schematically an example logic structure for sending a coupling stop signal in the form of an alarm signal to the Cab Speaker and a brake command signal to the brake sub-system. The CU in the CCTV includes an alarm flag 1 in the SSI which is sent to the TMS when the inter-train distance measured by the Image Processor becomes less than a predetermined threshold value. The CU has an AND logic circuit 104 and when the inter-train distance measured by the Image Processor becomes less than the predetermined threshold value, and the Image Processor detects that the other train's coupler cover is closed, the CU also includes an alarm flag 2 in the SSI which is sent to the TMS.

[0033] TMS has an AND logic circuit 105 and an OR logic circuit 106. The AND logic circuit 105 send a flag signal to the OR logic circuit 106 when the alarm flag signal 1 is included in the SSI and the coupler cover monitoring device 10 detects that the train unit's own cover is closed. The OR logic circuit 106 then outputs the alarm signal to the Cab Speaker and the brake command signal to the brake sub-system via the communication network in the train when it receives the flag signal from the AND logic circuit 105 or the alarm flag 2 is included in the SSI received from the CU.

[0034] Optionally, as shown in Figure 6, a traction ON signal and/or a brake OFF signal from the MMI can be included as an input to the AND logic circuit 105 in order to further reduce the likelihood of unnecessary alarms.

[0035] Figure 7 shows schematically a variant logic structure in which an alarm signal is sent from the CCTV to the Cab Monitor. The TMS includes an alarm flag in the TSI when the coupler cover monitoring device 10 detects that the train unit's own cover is closed. Optionally, a traction ON signal and/or a brake OFF signal from the MMI can be required in order that the alarm flag is included. For example, the TMS can have an AND logic circuit 107 which outputs the alarm flag on detection of a closed cover and the traction ON signal and/or the brake OFF signal.

[0036] The CU in the CCTV has an AND logic circuit 108, an AND logic circuit 109 and an OR logic circuit 110. The AND logic circuit 109 sends a flag to the OR logic circuit 110 when the alarm flag included in the TSI received from the TMS and the inter-train distance measured by the Image Processor is less than predetermined threshold value. The other AND logic circuit 108 sends a flag to the OR logic circuit 110 when the Image Processor detects that the coupler cover of the other train is closed and the inter-train distance measured by the Image Processor is less than a predetermined threshold value. The OR logic circuit 110 sends a coupling stop signal in the form of an alarm signal to the Cab Monitor when the OR logic circuit 110 receives the respective flag from either or both of AND logic circuit 108 and AND logic circuit 109.

[0037] Again, the inter-train distance can be displayed on the Cab Monitor in real time.

[0038] In the second embodiment, the coupler cover configuration of the other train can be detected by the front camera. Even if the driver of the train unit forgets to check the other train's coupler cover, the coupling support system can warn the driver and avoid damage to the other train.

[0039] Figures 8 to 10 relate to a third embodiment of a coupling support system.

[0040] In the first and second embodiments discussed above, the coupling support system sends an alarm signal to Cab Speaker or the CU of the CCTV sends an alarm signal to Cab Monitor. However, in the third embodiment, the TMS sends an alarm signal to both the Cab Speaker and the Cab Monitor. This can reduce the total processing load on the coupling support system. Figure 8 shows schematically one example of the coupling support system of the third embodiment. The main difference compared to the system of Figure 1 is that the CU now communicates with the Cab Monitor via the TMS.

[0041] Figure 9 shows schematically an example logic structure for sending an alarm signal from the TMS to the Cab Speaker and the Cab Monitor, and for sending a brake command signal to the brake sub-system. The logic structure for deciding if the alarm signal should be sent or not is the same as that of Figure 3. However, when it is determined that an alarm signal is to be sent by the TMS, this signal is sent to the Cab Speaker and the Cab Monitor.

[0042] Figure 10 shows schematically another example logic structure for the case when the CCTV has the additional ability to detect the coupler cover configuration of the other opposing train by using the camera image from the front camera. The logic structure for deciding if the alarm signal should be sent or not is the same as that of Figure 6. However, again, when it is determined that an alarm signal is to be sent by the TMS, this signal is sent to the Cab Speaker and the Cab Monitor.

[0043] Figures 11 to 13 relate to a fourth embodiment of a coupling support system.

[0044] In the first and second embodiments discussed above, the coupling support system sends an alarm signal to Cab Speaker or the CU of the CCTV sends an alarm signal to Cab Monitor. However, in the fourth embodiment, the CU of the CCTV sends an alarm signal to both the Cab Speaker and the Cab Monitor. This can also reduce the total processing load on the coupling support system. Figure 11 shows schematically one example of the coupling support system of the fourth embodiment. The main difference compared to the system of Figure 1 is that the TMS now communicates with the Cab Speaker via the CU.

[0045] Figure 12 shows schematically an example logic structure for sending an alarm signal from the CU to the Cab Speaker and the Cab Monitor. The logic structure for deciding if the alarm signal should be sent or not is the same as that of Figure 4. However, when it is determined that an alarm signal is to be sent by the CU, this signal is sent to the Cab Speaker and the Cab Monitor.

[0046] Figure 13 shows schematically another example logic structure for the case when the CCTV has the additional ability to detect the coupler cover configuration of the other opposing train by using the camera image from the front camera. The logic structure for deciding if the alarm signal should be sent or not is the same as that of Figure 7. However, again, when it is determined that an alarm signal is to be sent by the TMS, this signal is sent to the Cab Speaker and the Cab Monitor.

[0047] In the second to fourth embodiments discussed above, a front camera image is used for measuring the inter-train distance. However, other means for measuring this distance can be used, such as radar, lidar etc.

[0048] While the disclosure has been described in conjunction with the exemplary embodiments described above, many equivalent modifications and variations will be apparent to those skilled in the art when given this disclosure. Accordingly, the exemplary embodiments of the disclosure set forth above are considered to be illustrative and not limiting. Moreover, in determining extent of protection, due account shall be taken of any element which is equivalent to an element specified in the claims.

Claims

1. A support system for supporting a coupling operation between a first train unit and a second train unit, each train unit having a respective coupler for coupling to the coupler of the other train unit, and a respective coupler cover which is movable between a closed

configuration in which the cover covers its coupler and an open configuration in which the coupler is revealed to allow coupling, the support system including:

a distance measuring device mountable at a front of the first train unit and operable to measure a distance between the first train unit and the second train unit;
a coupler cover monitoring device mountable to the first train unit and operable to detect an open or closed configuration status of the first train unit's coupler cover; and
a protection sub-system mountable to the first train unit, the protection sub-system receiving a distance measurement from the distance measuring device and a configuration status from the coupler cover monitoring device, and issuing a coupling stop signal when the distance measurement is less than a predetermined threshold distance and the configuration status indicates the first train unit's coupler cover is closed.

2. The support system according to claim 1 further including a driver alert sub-system connected to the protection sub-system, the driver alert sub-system issuing a warning to a driver of the first train unit on receipt of the coupling stop signal.

3. The support system according to claim 1 or 2 further including a brake sub-system connected to the protection sub-system, the brake sub-system applying brakes of the first train unit on receipt of the coupling stop signal.

4. The support system according to any one of the previous claims, wherein the distance measuring device comprises a camera which obtains an image of the front of the second train unit, and an image processing unit which determines the distance between the first train unit and the second train unit from the obtained image.

5. The support system according to claim 4, wherein the image processing unit also determines the open or closed configuration status of the coupler cover of the second train unit from the obtained image, and the protection sub-system also issues the coupling stop signal when the distance measurement is less than a predetermined threshold distance and the image processing unit determines the second train unit's coupler cover is closed.

6. The support system according to any one of the previous claims, wherein the protection sub-system receives a signal indicating whether a traction sub-system of the train unit is operating or not operating, and only the issues the coupling stop signal when the traction sub-system is operating.

7. The support system according to any one of the previous claims, wherein the protection sub-system receives a signal indicating whether brakes of the train unit are on or off, and only the issues the coupling stop signal when the brakes are off.

8. The support system according to any one of the previous claims, wherein the protection sub-system receives a signal indicating a running direction of a train of which the train unit is a component, and only issues the coupling stop signal when the train running direction indicates that the first train unit is a head unit of the train.

9. A train unit having:

a coupler for coupling to the coupler of another train unit;
a coupler cover which is movable between a closed configuration in which the cover covers the coupler and an open configuration in which the coupler is revealed to allow coupling; and
the support system of any one of the previous claims mounted thereto for supporting a coupling operation between the train unit and the other train unit.

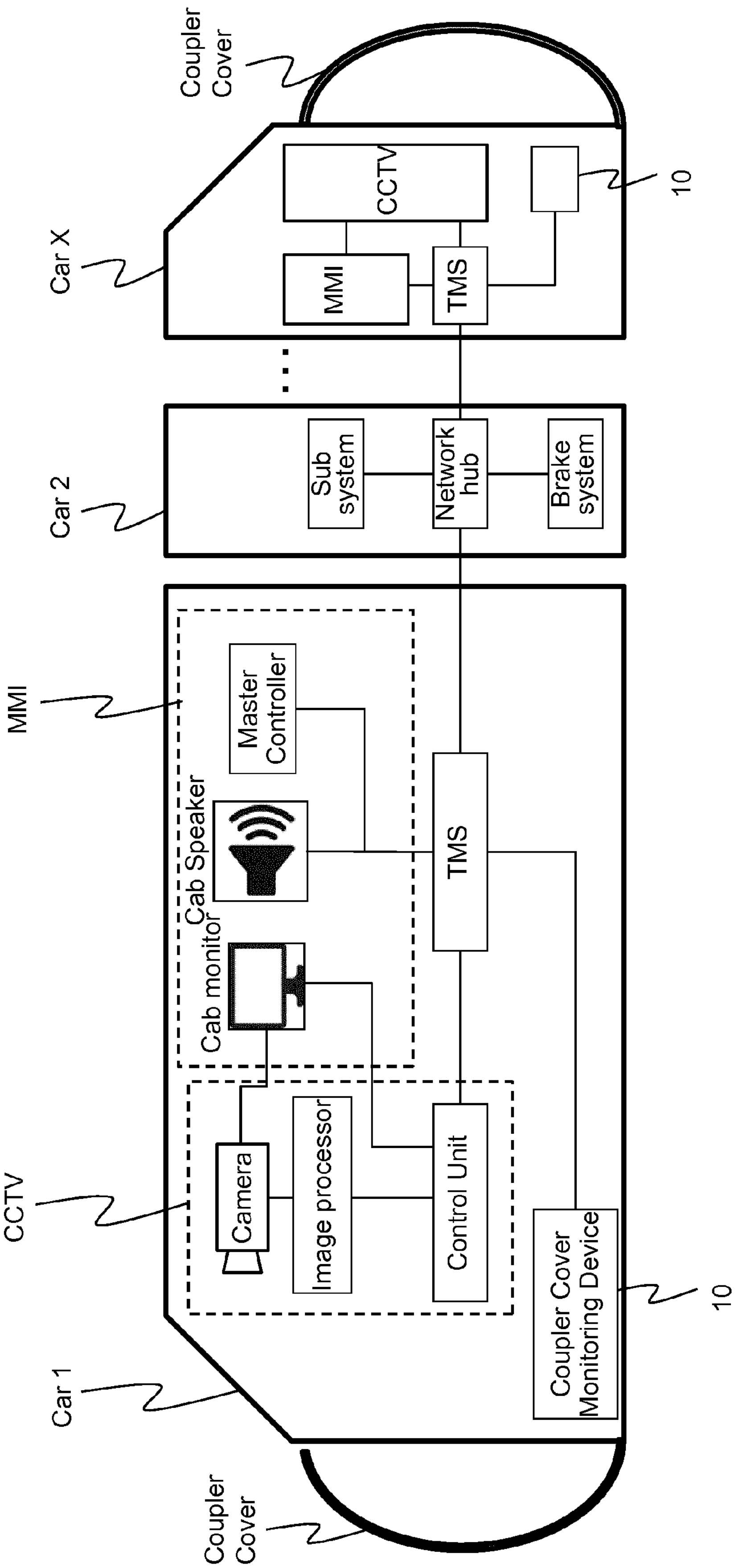

Coupler Cover
CCTV
10
Car X
MMI
TMS
Car 2
Sub system
Network hub
Brake system
MMI
Master Controller
Cab Speaker
Cab monitor
TMS
CCTV
Camera
Image processor
Control Unit
Coupler Cover Monitoring Device
10
Car 1
Coupler Cover

Fig. 1

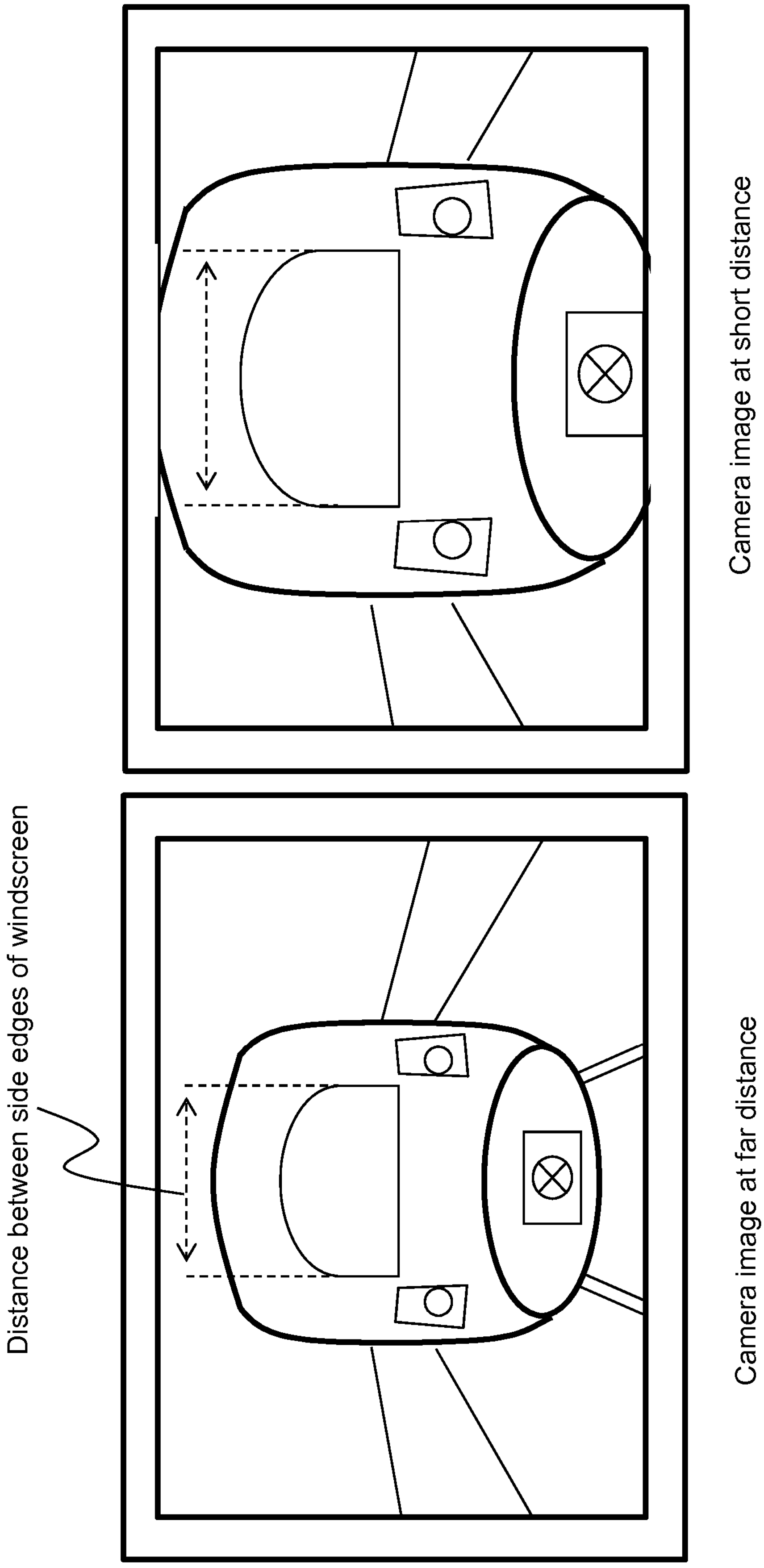

Camera image at short distance
Distance between side edges of windscreen
Camera image at far distance

Fig. 2

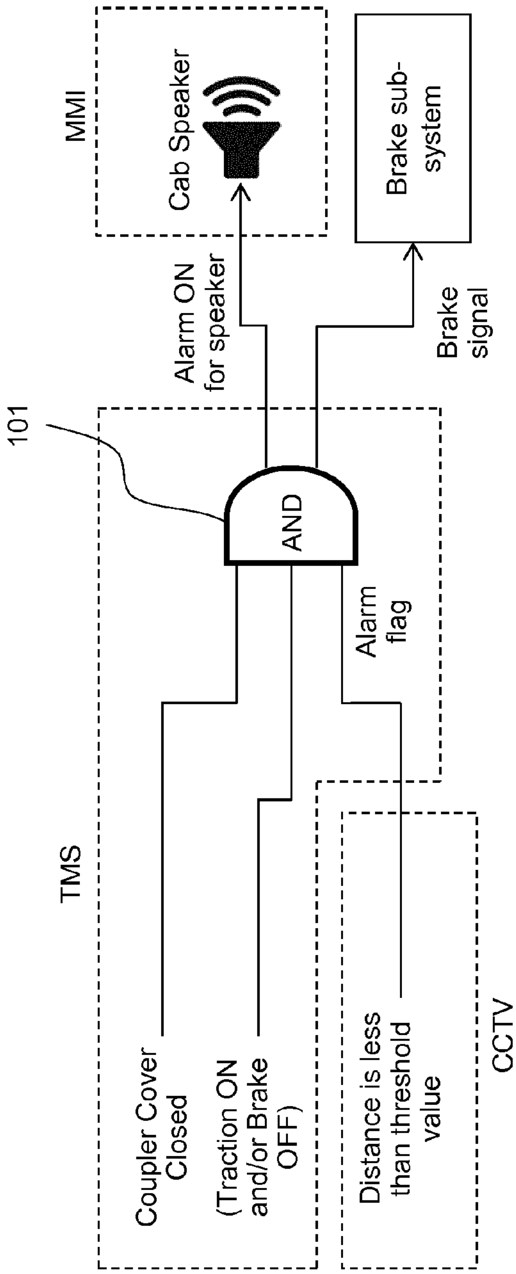

101
TMS
Coupler Cover Closed
(Traction ON and/or Brake OFF)
AND
Alarm flag
Distance is less than threshold value
CCTV
Alarm ON for speaker
Brake signal
MMI
Cab Speaker
Brake sub-system

Fig. 3

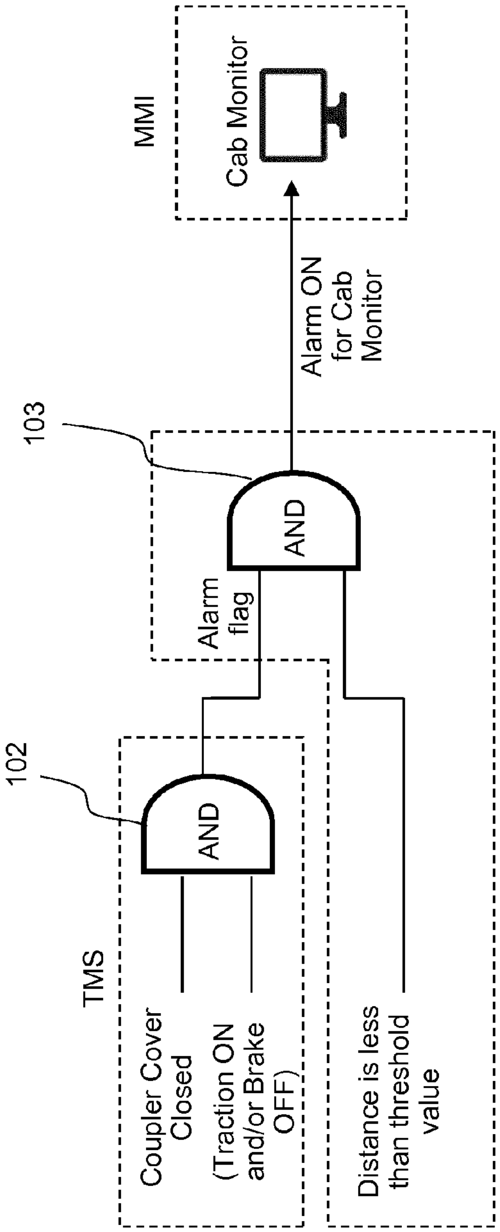
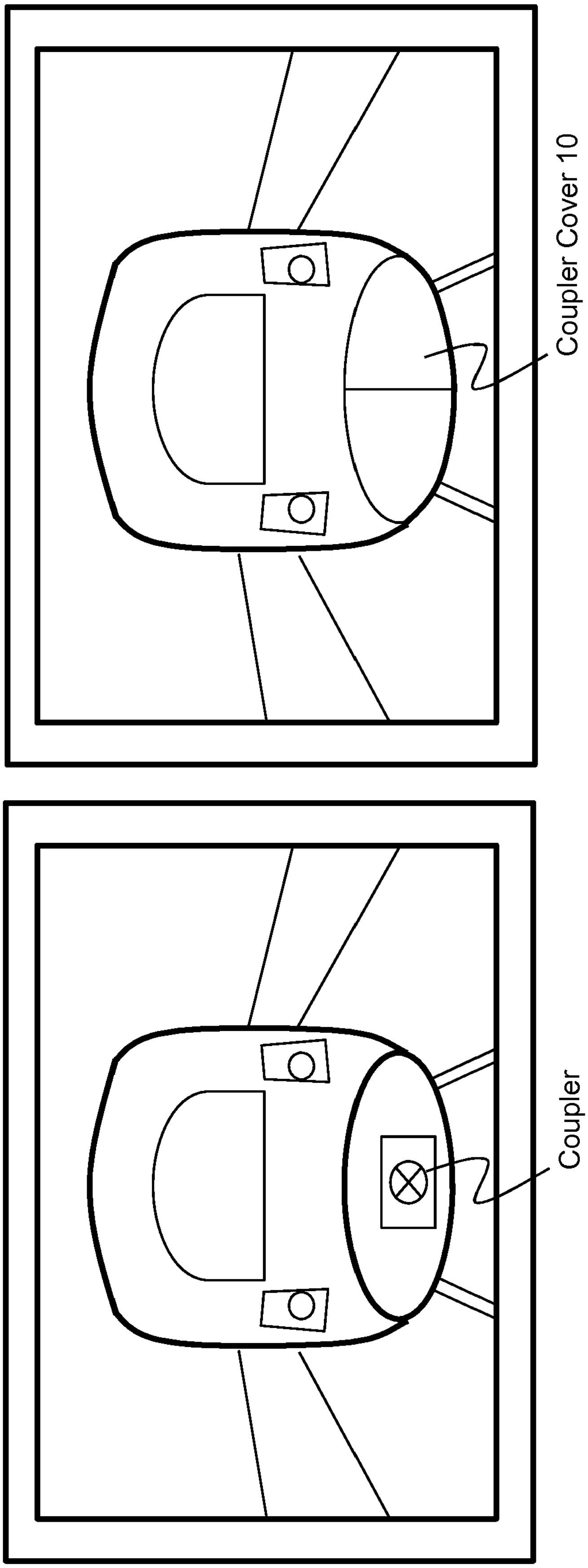

102
103
TMS
Coupler Cover Closed
(Traction ON and/or Brake OFF)
AND
AND
Alarm flag
Distance is less than threshold value
CCTV
Alarm ON for Cab Monitor
MMI
Cab Monitor

Fig. 4



Camera image when cover opened

Camera image when cover closed

Fig. 5

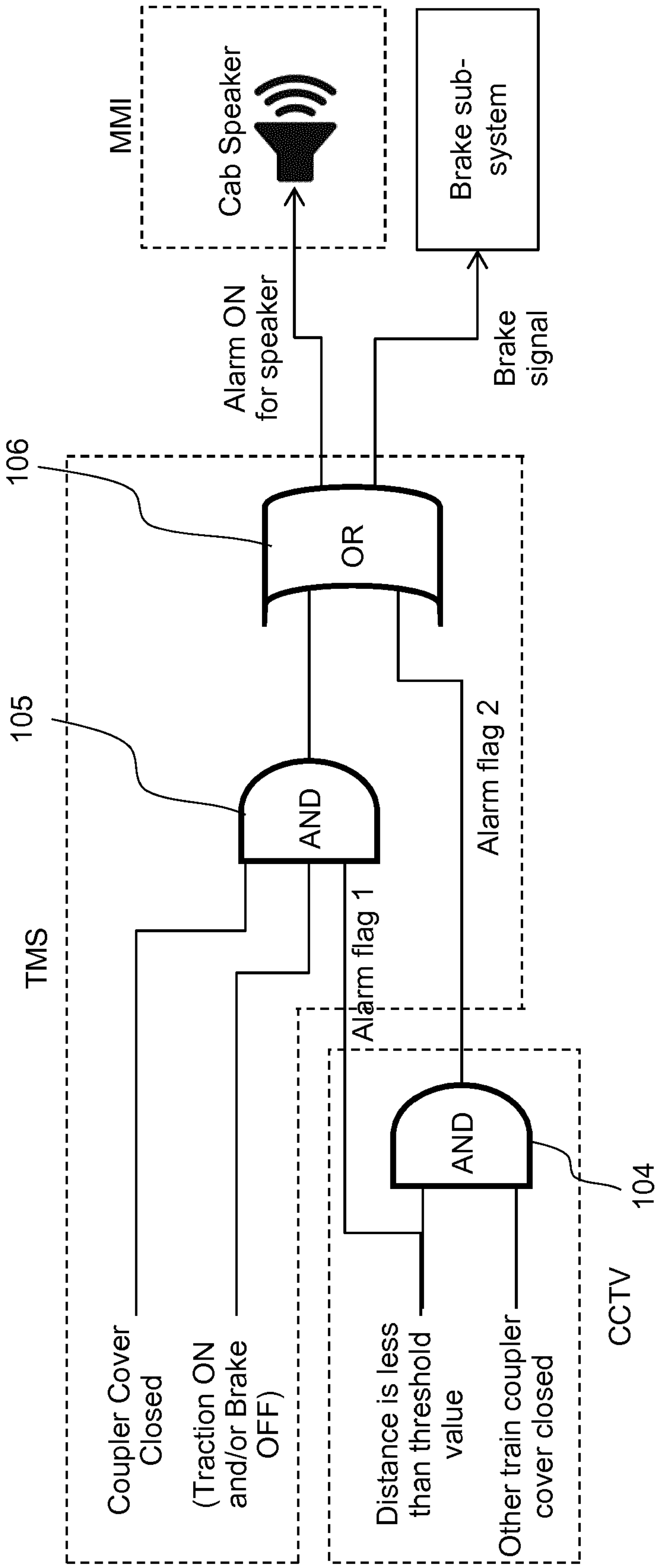

MMI
Cab Speaker
Brake sub-system
Alarm ON for speaker
Brake signal
106
OR
105
AND
TMS
Alarm flag 2
Alarm flag 1
AND
104
Coupler Cover Closed
(Traction ON and/or Brake OFF)
Distance is less than threshold value
Other train coupler cover closed
CCTV

Fig. 6

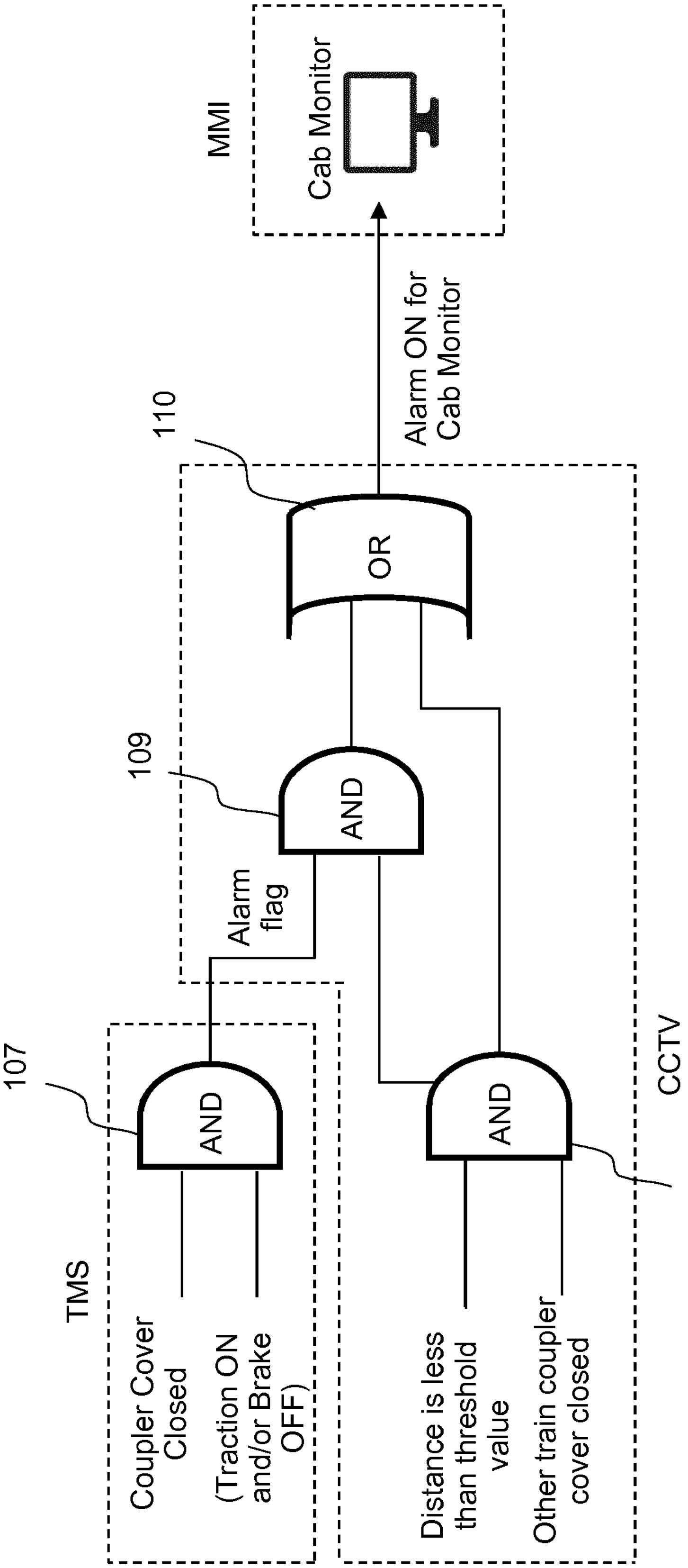

MMI
Cab Monitor
Alarm ON for Cab Monitor
110
OR
109
AND
Alarm flag
107
AND
TMS
Coupler Cover Closed
(Traction ON and/or Brake OFF)
CCTV
AND
108
Distance is less than threshold value
Other train coupler cover closed

Fig. 7

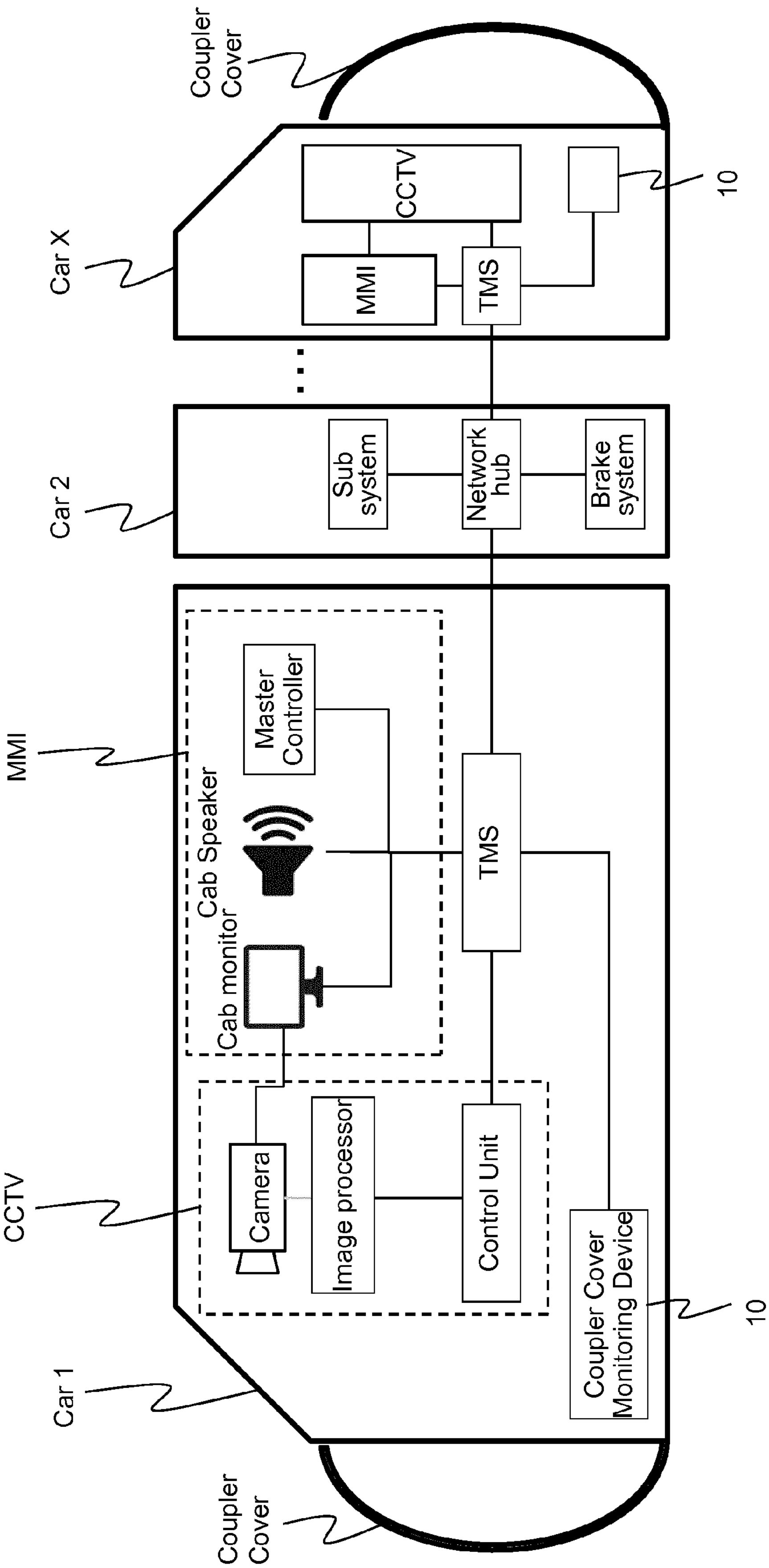

Coupler Cover
Car X
CCTV
MMI
TMS
10
Car 2
Sub system
Network hub
Brake system
MMI
Cab Speaker
Cab monitor
Master Controller
TMS
CCTV
Camera
Image processor
Control Unit
Coupler Cover Monitoring Device
10
Car 1
Coupler Cover

Fig. 8

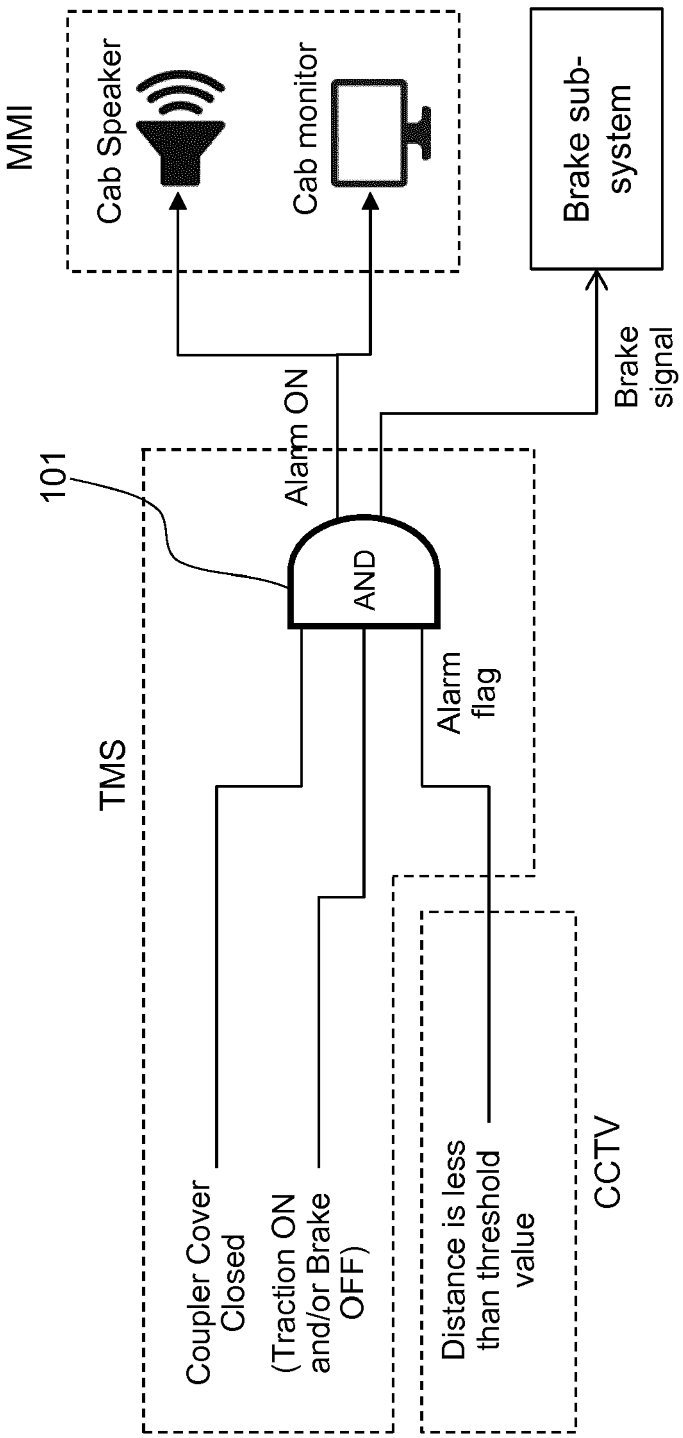

MMI
Cab Speaker
Cab monitor
Brake sub-system
Brake signal
Alarm ON
101
AND
TMS
Alarm flag
Coupler Cover Closed
(Traction ON and/or Brake OFF)
Distance is less than threshold value
CCTV

Fig. 9

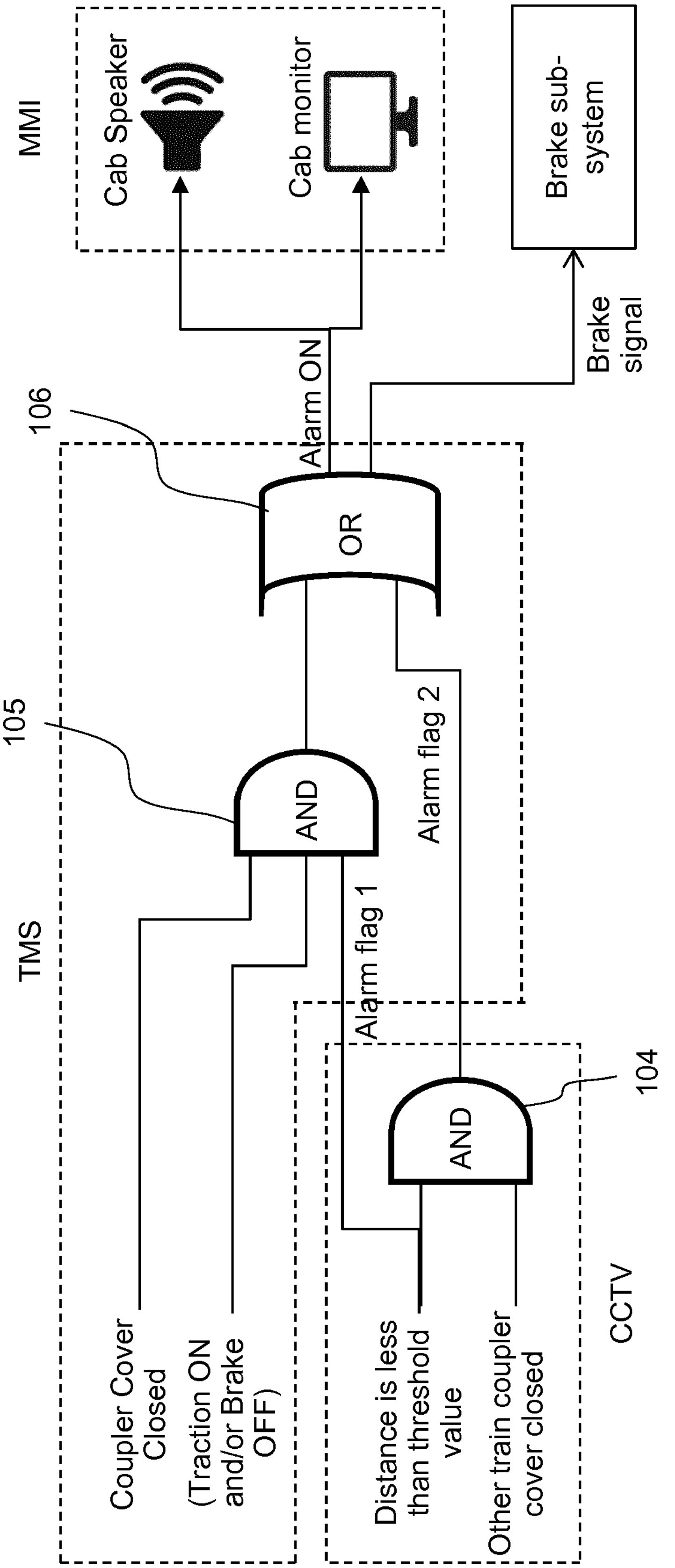

MMI
Cab Speaker
Cab monitor
Brake sub-system
Brake signal
Alarm ON
106
OR
105
AND
Alarm flag 2
Alarm flag 1
TMS
104
AND
Coupler Cover Closed
(Traction ON and/or Brake OFF)
Distance is less than threshold value
Other train coupler cover closed
CCTV

Fig. 10

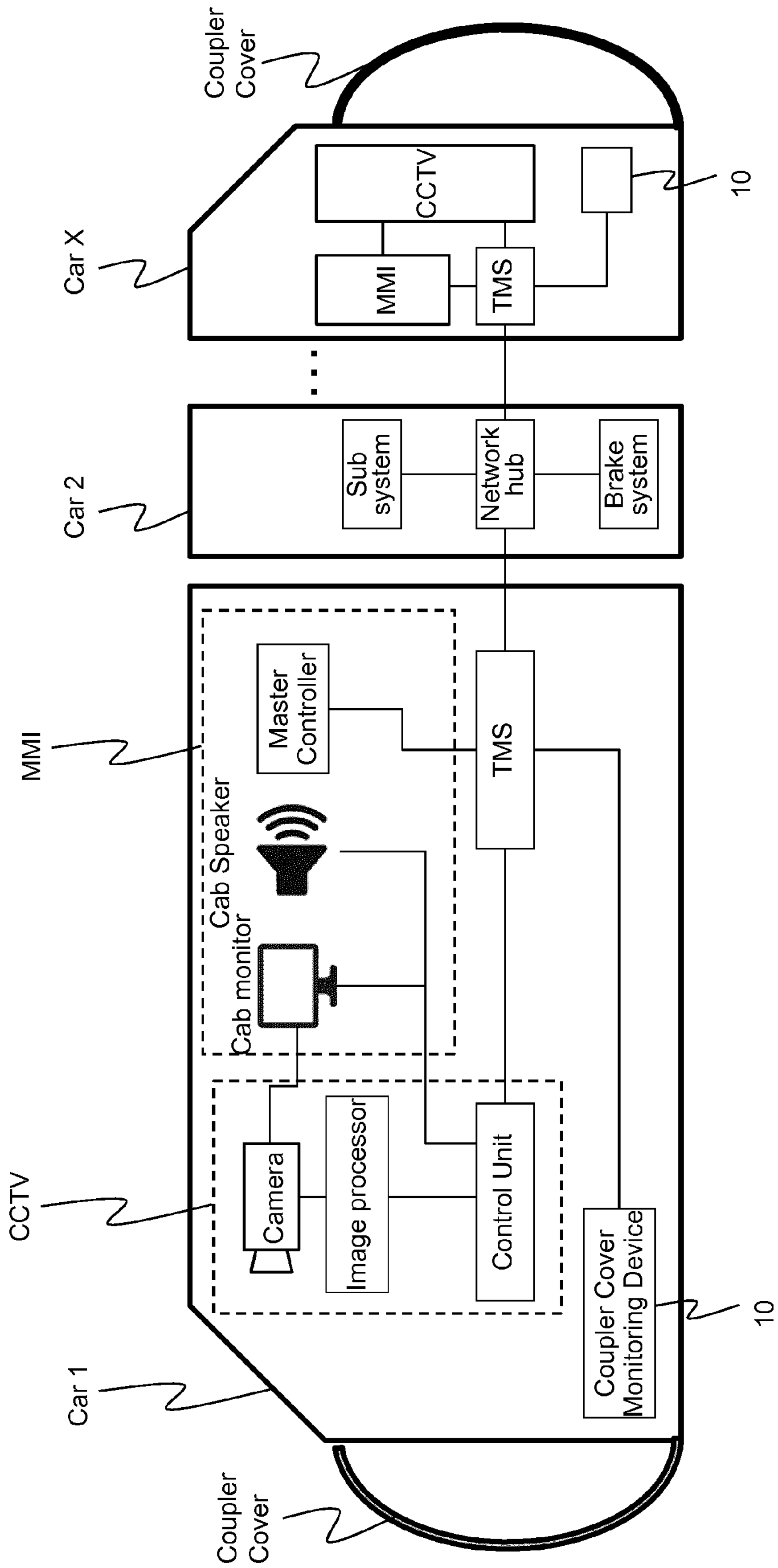

Coupler Cover
Car X
CCTV
MMI
TMS
10
Car 2
Sub system
Network hub
Brake system
MMI
Master Controller
TMS
Cab Speaker
Cab monitor
CCTV
Camera
Image processor
Control Unit
Coupler Cover Monitoring Device
10
Car 1
Coupler Cover

Fig. 11

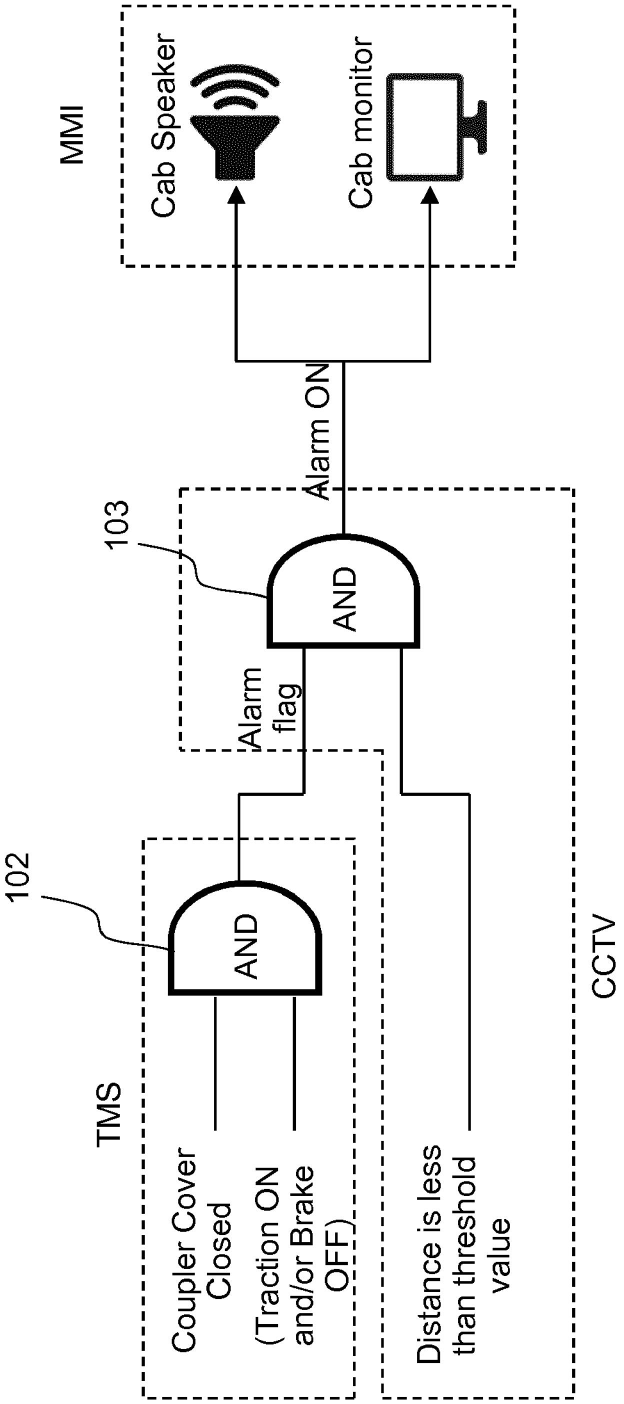

MMI
Cab Speaker
Cab monitor
Alarm ON
103
AND
Alarm flag
102
AND
TMS
Coupler Cover Closed
(Traction ON and/or Brake OFF)
Distance is less than threshold value
CCTV

Fig. 12

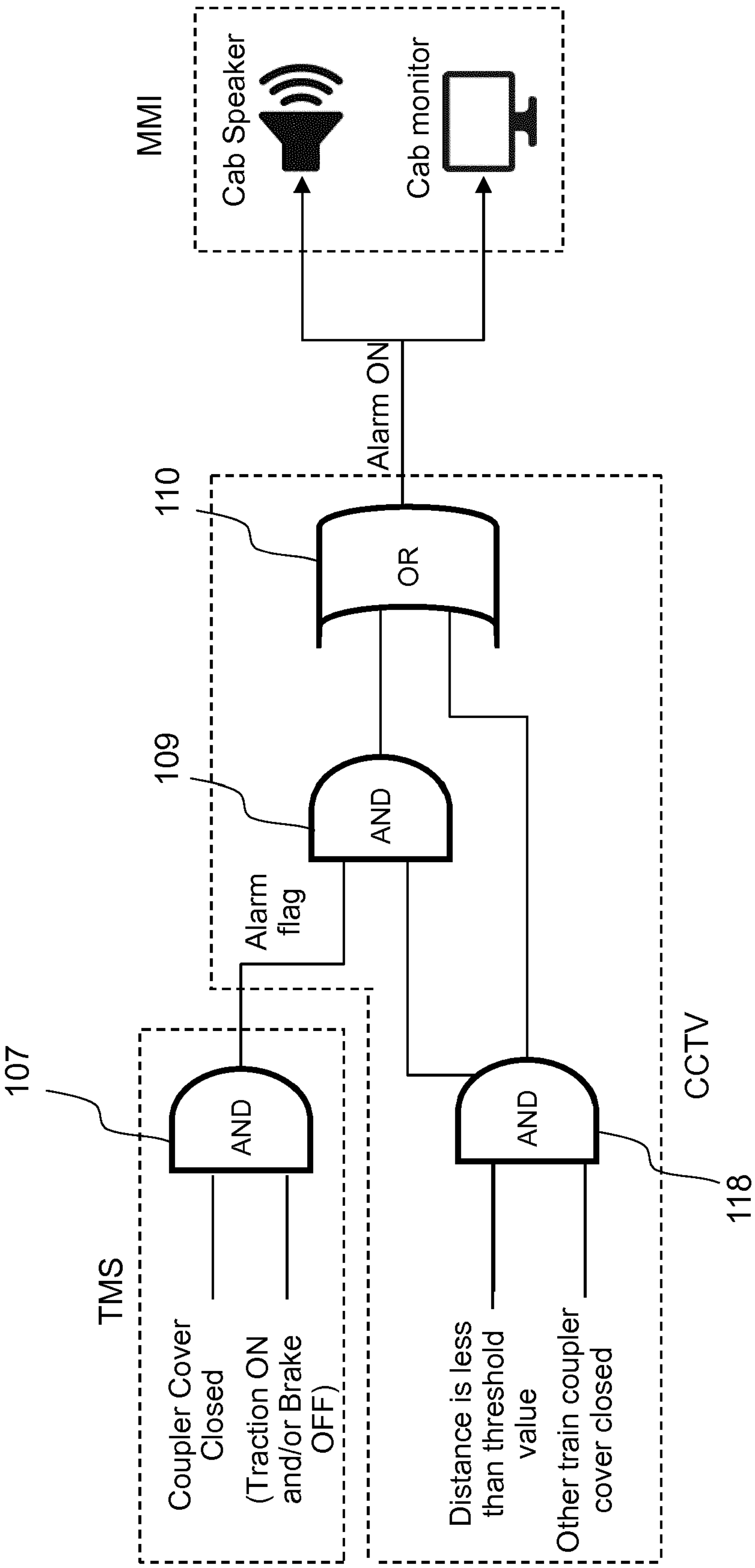

MMI
Cab Speaker
Cab monitor
Alarm ON
110
OR
109
AND
Alarm flag
107
AND
TMS
Coupler Cover Closed
(Traction ON and/or Brake OFF)
AND
118
CCTV
Distance is less than threshold value
Other train coupler cover closed

Fig. 13

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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 3745

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 10 2012 009114 A1 (DB FERNVERKEHR AG [DE]) 14 November 2013 (2013-11-14) * paragraph [0001] * * paragraph [0009] * * paragraph [0013] * * paragraph [0022]; figure 1 * -----	1-3,6-9 4,5	INV. B61L15/00 B61L23/04 ADD. B61L23/34
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A	JP 2011 254666 A (MITSUBISHI ELECTRIC CORP; HIGASHI NIPPON RYOKAKU TETSUDO) 15 December 2011 (2011-12-15) * the whole document * -----	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

B61L

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	11 February 2020	Pita Priegue, Miguel

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11-02-2020

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