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(54) **METHOD FOR CONTROLLING A RAIL VEHICLE WITHIN A WORKING AREA, CONTROL SYSTEM AND USE OF AN EXTERNAL CONTROL DEVICE**

(57) A method for controlling a rail vehicle (12) within a working area is provided, wherein a working area (16) is allocated (104) to the rail vehicle (12) by an external control device (14), wherein the external control device (14) determines (110) the position of the rail vehicle (12) within the working area (16), and wherein the external

control device (14) controls a driving condition of the rail vehicle (12), in order to prevent the rail vehicle (12) from leaving the working area (16). This method allows save operation of a rail vehicle within a working area of a railway network.

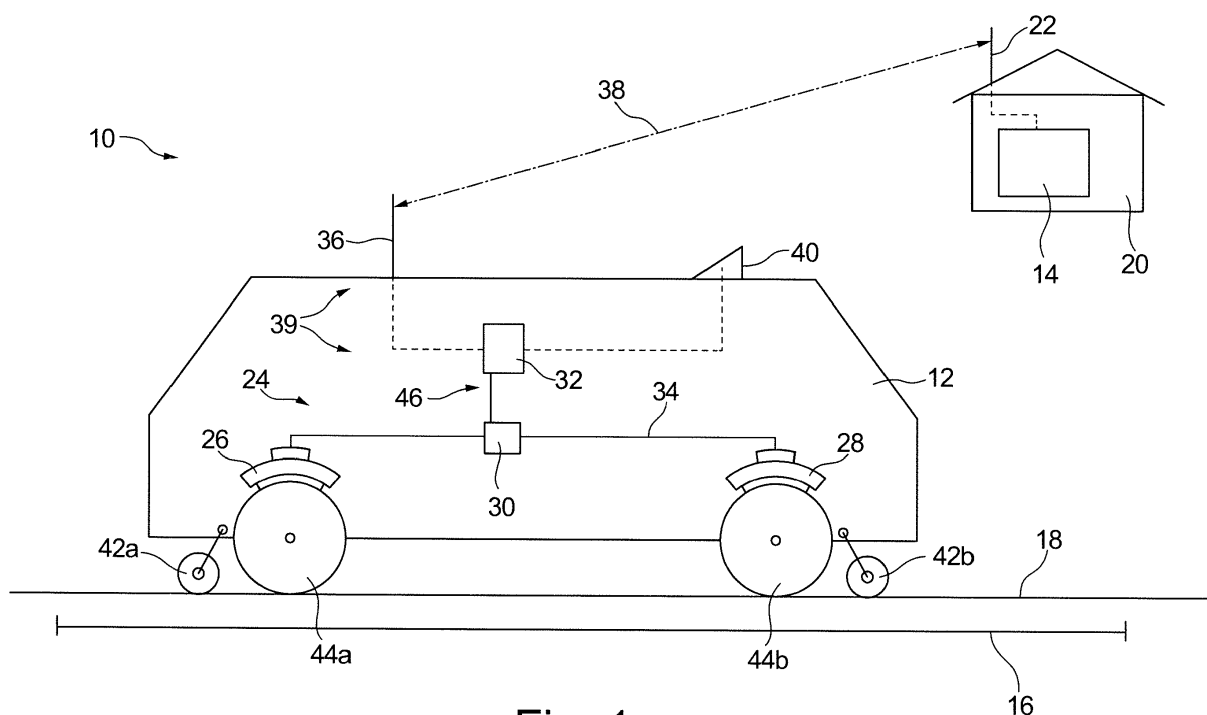


Fig. 1

Description

Background of the invention

[0001] The invention concerns a method for controlling a rail vehicle. The invention also concerns a control system comprising a rail vehicle and an external control device. The invention further relates to a use of an external control device for controlling a rail vehicle.

[0002] For maintenance of railway tracks maintenance vehicles have to operate safely at the track sections to be maintained. Therefore a possession area comprising the relevant track sections is assigned to the maintenance vehicle, i.e. the possession area must not be entered by other vehicles in order to ensure safety for working personnel within the possession area. A Possession area is therefore forbidden for any other vehicle. Further it is important that the maintenance vehicle does not leave the possession area. It is known to use a mobile possession terminal (see "Evolution des Integrierten Bedienplatzes am Beispiel North-South Railway Saudi-Arabien", Frank Schneider, Michael Schäfer, Volkmar Heuer in: SIGNAL + DRAHT 12/2012 - pages 33-36), i.e. a specifically equipped laptop or the like, to control a specific possession area assigned to a rail vehicle, such as a hi-rail vehicle or a track-maintenance vehicle. Subsequently, the mobile possession terminal serves to display the position of the rail vehicle within the possession area to a driver of the rail vehicle. Thus the driver is responsible to check whether the vehicle moves within the possession area or not. Yet, in case that driver does not recognize that the maintenance vehicle moves out of the possession area the vehicle is exposed to the danger of collisions.

[0003] A similar problem occurs during shunting processes, if the shunting engine leaves the shunting area. A shunting area is a designated area where shunting moves are performed, e.g. stabling of trains.

[0004] European Railways use a standardised European Train Control System (ETCS), especially on high speed lines, to prevent a train from exceeding a predefined speed or driving distance (https://en.wikipedia.org/wiki/European_Train_Control_System). The trains are equipped with onboard units (OBU), which are permanently integrated within the trains and control the train speed. However, ETCS is designed for the (mostly) unidirectional movement of long-distance trains. Thus, this approach is suitable for unidirectional travelling of trains. With an ETCS system it is not consistently possible, to prevent a train from leaving a limited two-dimensional area (working area) appointed to a train, because no standardization was needed in Europe for local train movement in such areas like a shunting area. Furthermore ETCS is not suitable for repeated changes of a travelling direction within a possession area. Furthermore certification of such an onboard unit and installation of the required ETCS track site equipment is extremely expensive. Thus, for financial reasons, track maintenance

and hi-rail vehicles are usually not equipped with permanently installed safety and control means.

Object of the invention

[0005] It is therefore an object of the invention to provide a method for safe operation of a rail vehicle within a working area of a railway network.

Description of the invention

[0006] This object is solved by a method according to claim 1, a control system according to claim 8, and a use according to claim 16.

[0007] According to the invention, a method for controlling a rail vehicle in particular a hi-rail vehicle or a track maintenance vehicle or a shunting engine, within a working area is provided, wherein the working area is allocated to the rail vehicle by an external control device, wherein the external control device determines the position of the rail vehicle within the working area, and wherein the external control device controls a driving condition parameter of the rail vehicle, in order to prevent the rail vehicle from leaving the working area.

[0008] Any vehicle, which is suited to be driven on a railway, is considered as a rail vehicle, i.e. the rail vehicle is not necessarily limited to be driven only on a railway, e.g. hi-rail vehicle (road-rail vehicle, two-way vehicle).

[0009] The working area may be a one dimensional or, preferably, a two dimensional section of a railway network, i.e. the working area may comprise switches and branching rail track sections. The term "one dimensional" is to be understood as referring to a line-shaped track segment comprising one or more track sections without branches. The term "two-dimensional" is to be understood as referring to a track segment comprising at least one branching track section and a switch. The working area is exclusively reserved to be entered by one designated rail vehicle or by several designated rail vehicles; any other vehicles are prohibited to enter the working area without acknowledgement of a designated responsible person, e.g. the driver of the rail vehicle. In particular, the working area may be a possession area or a shunting area. If more than one rail vehicles are being operated within the working area, the further rail vehicles may be controlled by the external control device or by further external control devices.

[0010] The external control device is a control device, which can be located within the rail vehicle, but it is not part of the rail vehicle nor is it permanently mounted to the rail vehicle.

[0011] Allocation of the working area to the rail vehicle can easily and conveniently be accomplished by the external control device. In order to do so, the external control device may communicate, i.e. exchange data and/or orders, with an operator entity.

[0012] The position of the rail vehicle within the working area is calculated from an absolute position of the rail

vehicle and position data concerning an extension of the working area. The driver of the rail vehicle may be provided with this information. The extension of the working area is known to the external control device from the allocation step. The absolute position of the rail vehicle may be determined by the external control device itself, if the external device is a mobile device aboard the rail vehicle, or by means of an additional position determination device, e.g. via a GPS-receiver, balises, manual input of track or marker board, or a tag reader. Thus, the external control device may easily compare the absolute position of the rail vehicle with the extension data of the working area. Controlling the driving condition of the rail vehicle comprises evaluation of the position of the rail vehicle within the working area with respect to borders of the working area.

[0013] By controlling the driving condition of the rail vehicle, the method according to the invention effectively prevents the rail vehicle from leaving the working area. This increases safety for the rail vehicle and for other vehicles or persons outside the working area. The driving condition may particularly comprise a driving speed, a brake operation state such as a braking pressure, and/or a torque or a power delivered by a propulsion engine of the rail vehicle.

[0014] According to the invention the control of the driving condition is carried out by the external control device. The external control device may be a mobile device (e.g. a laptop) or a central computer. One external control device may control several rail vehicles at a time. One external control device may also control several rail vehicles consecutively. Thereby, hardware costs are reduced as compared to a permanently installed onboard unit.

[0015] The method according to the invention allows for cost efficient and safe operation of rail vehicles, in particular of track maintenance vehicles, hi-rail vehicles or shunting engines. In particular, the method according to the invention enables rail vehicles to be operated with a safety integrity level (SIL) according to EN 50129 of at least SIL 1.

[0016] In a preferred variant, the external control device controls the driving speed of the rail vehicle. The driving speed can easily be controlled by adjusting a power or a torque provided by a propulsion engine of the rail vehicle.

[0017] It is highly preferred, that the external control device operates a braking system of the rail vehicle. This allows the external control device to reduce the driving speed of the rail vehicle and to rapidly stop the rail vehicle.

[0018] In a preferential variant, the external control device initiates an emergency braking, if the rail vehicle is about to leave the working area. This enhances the control method with respect to preventing the rail vehicle from accidentally leaving the working area. The emergency braking typically uses all of the available braking performance of the rail vehicle. The emergency braking may be initiated if the rail vehicle approaches a boundary

of the working area closer than a security distance, which may be predefined or calculated based on the driving speed of the rail vehicle, a pre-known braking performance of the rail vehicle, the weight of the rail vehicle and/or a condition of the rail tracks within the working area.

[0019] It is preferred, that the external control device determines an extension of the working area. Thus, no further equipment is required for this purpose.

[0020] In a highly preferred variant, the external control device determines the extension of the working area by choosing predefined track elements of a railway network. Thus, arbitrary working areas can readily be constructed by selecting adjacent track elements. The track elements to be chosen may be preselected by the driver of the rail vehicle, a central operator, or by coordination of the driver and the operator. A track element may be any kind of longitudinal rail track section, on which the rail vehicle can travel. Typically, the preexisting definition of the track elements is not altered unless the railway network is modified or reconstructed.

[0021] In a particularly advantageous variant, the external control device determines the extension of the working area by choosing predefined end points to limit the working area. Thus, the working area can be constructed as the contiguous area of track sections between the end points. Knowledge of the track layout is not explicitly required to define the working area. The end points to be chosen may be preselected by the driver of the rail vehicle, a central operator, or by coordination of the driver and the operator. An end point may be located anywhere on the rail track. Typically the preexisting definition of the end points is not altered unless the railway network is modified or reconstructed.

[0022] In a particularly preferred variant the external control device is operated in a one channel safe procedure. Thereby, operational safety requirements such as procedural reliability can be met without the need for redundant equipment. In particular, principles of reactive fail-safety or inherent fail-safety according to EN 50129 can be met.

[0023] In an advantageous variant, the external control device controls a driving condition parameter of a further rail vehicle. The further rail vehicle may be operated within the same working area as the rail vehicle. Alternatively, the further rail vehicle may be operated in a further working area. The respective working area may be allocated to the further rail vehicle by the external control device. The external control device may also determine the position of the further rail vehicle within the working area or within the further working area. This variant allows efficiently controlling several rail vehicles. Additional equipment for controlling the further rail vehicle can be avoided.

[0024] The invention also concerns a control system comprising a rail vehicle and an external control device, wherein the external control device is configured to allocate a working area to the rail vehicle, wherein the external control device is configured to determine the position of the rail vehicle within the working area, and

wherein an interface is provided to operably connect the external control device to a brake control unit of a braking system of the rail vehicle. This system can be conveniently controlled with the method of the invention. In particular, the braking system of the rail vehicle may be operated by the external control device, i.e. the external control device may trigger an application of the braking system of the rail vehicle. The brake control unit may be part of an electronic control unit of the vehicle. Typically, the brake control unit controls a brake actuator of the braking system. The external control device and the brake control unit are configured to be operably connected via the interface. The interface provides a connection between the external control device and the brake control unit. By providing an external control device rail vehicles, which are not equipped with a train protection system with onboard unit, such as ETCS, can be safely controlled within a working area.

[0025] In an advantageous embodiment the rail vehicle has a hydraulic braking system. This allows integration of smaller (lighter) rail vehicles, such as hi-rail vehicles, which are typically equipped with a hydraulic braking system, in the control system according to the invention.

[0026] In an alternative, preferred embodiment the rail vehicle has a pneumatic braking system. Bigger (heavier) rail vehicles typically have a pneumatic braking system.

[0027] In a preferred embodiment the interface comprises a vehicle bus system, in particular a controller area network. The vehicle bus system allows to conveniently monitor a driving condition of the rail vehicle and to operate the braking system via the external control device. A controller area network is particularly suitable for these purposes.

[0028] It is highly preferred that the interface comprises a wireless connection between the external control device and the brake control unit. The wireless connection can easily be established. In particular, the wireless connection allows providing an interface to an external control device at a remote location, i.e. outside the rail vehicle. The wireless connection may be a radio circuit, a wireless local area network, or a Bluetooth connection. A Bluetooth connection may be established by an adapter device for a controller area network (e.g. an OBD2-CAN-Bus) of the rail vehicle.

[0029] In an advantageous embodiment the brake control unit is provided within a head of train device or within an end of train device. The head of train device or the end of train device provide a possibility for operating the braking system. They may also provide the interface independently from the rail vehicle. By using a head of train device or an end of train device the control system according to the invention can be established without modifications to a control structure of the rail vehicle. Thus, (re)obtaining an official technical approval for the rail vehicle can be avoided. A head of train device is demountably attachable at a front end of the rail vehicle. An end of train device is demountably attachable at a rear end of the rail vehicle. The head of train device or the end of

train device may be easily mounted to the rail vehicle upon demand to establish the control system of the invention.

[0030] In a particularly preferred embodiment the external control device is a mobile device. The mobile device is a portable unit, which can be temporarily positioned within the rail vehicle and can be removed from the rail vehicle without disassembly work. Typically, the mobile device comprises means for data input and output, such as a display, a touchscreen, a keyboard or the like. According to the invention, the mobile device may be used with several rail vehicles subsequently. One mobile device may also control several rail vehicles at a time. This allows reducing costs for implementation of the invention. Typically, the mobile device is arranged inside of the rail vehicle during operation. Alternatively, the mobile device may be arranged outside the rail vehicle at a track site.

[0031] It is highly preferred that the mobile device is a portable personal computer. Portable personal computers, such as laptops, are readily available at a moderate price.

[0032] In another, particularly preferred embodiment the external control device is a central computer. This allows further reducing provisioning costs. The central computer may control several rail vehicles at a time. It may also control several rail vehicles subsequently. The central computer is arranged at a location, in particular at a fixed location, outside the rail vehicle. If the central computer is used as the external control device, a secondary mobile device may be provided within the rail vehicle to allow communication between the driver of the rail vehicle and the central computer. In this case, the secondary mobile device is typically not used to control the rail vehicle.

[0033] In an advantageous embodiment the rail vehicle is a hi-rail vehicle. Hi-rail vehicles are typically operated in working areas and are endangered to be accidentally driven outside their reserved working area. Yet, for financial reasons they are typically not equipped with a fixedly installed onboard system, to prevent such endangerments.

[0034] The invention also relates to a use of an external control device for controlling a driving condition, in particular the driving speed, of a rail vehicle within a working area. This allows easily controlling the rail vehicle within a working area, as an external control device can be provided independently of the respective rail vehicle.

[0035] Further advantages can be extracted from the description and the enclosed drawing. The features mentioned above and below can be used in accordance with the invention either individually or collectively in any combination. The embodiments mentioned are not to be understood as exhaustive enumeration but rather have exemplary character for the description of the invention.

Drawings

[0036] The invention is shown in the drawing.

FIG. 1 shows a schematic sketch of a first embodiment of a control system according to the invention comprising a hi-rail vehicle and a central external control device.

FIG. 2 shows a schematic sketch of a second embodiment of a control system according to the invention comprising a track maintenance vehicle and a mobile external control device.

FIG. 3 shows a schematic sketch of a third embodiment of a control system according to the invention comprising a mobile external control device and two rail vehicles.

FIG. 4 depicts a flow chart of a method according to the invention.

FIG. 5 shows a secured route within a railway network according to prior art.

FIG. 6 shows a working area selected on basis of predefined track elements according to the invention.

FIG. 7 shows a working area selected on basis of predefined end points according to the invention.

[0037] FIG. 1 shows a first embodiment of a control system 10 according to the invention comprising a rail vehicle 12 and an external control device 14. Rail vehicle 12 is positioned within a working area 16 of a rail track 18. In the embodiment shown in FIG. 1, the external control device 14 is a central computer located at a facility 20. External control device 14 is connected to a central antenna 22.

[0038] The rail vehicle 12 has a braking system 24. In the shown embodiment, the braking system 24 comprises a front brake 26, a rear brake 28 and a brake control unit 30. Brake control unit 30 is connected to an electronic control unit 32 of the rail vehicle 12 via a vehicle bus system 46. Here, vehicle bus system 46 is designed as a controller area network. Here, braking system 24 is designed as a hydraulic braking system. Braking system 24 is actuated by brake control unit 30 via brake lines 34.

[0039] The electronic control unit 32 is connected to a vehicle antenna 36. A wireless connection 38 is established between the external control device 14 and the electronic control unit 32 as a radio circuit between central antenna 22 and vehicle antenna 36. Thus, vehicle bus system 46, electronic control unit 32 and vehicle antenna 36 provide an interface 39, which allows external control device 14 to operate braking system 24.

[0040] In an alternative embodiment (not depicted), ex-

ternal control device 14 may be designed as a mobile control device. Said mobile control device may be disposed aboard rail vehicle 12 and may be plugged to vehicle bus system 46 via a wire or a docking station.

[0041] In the depicted embodiment, a GPS receiver 40 is disposed on the rail vehicle 12 and connected to the electronic control unit 32. An absolute position of the rail vehicle 12 is determined by GPS receiver 40 and transmitted to the external control device 14 via wireless connection 38. The external control device 14 compares the absolute position of rail vehicle 12 with an extension of working area 16. If the external control device 14 detects that the rail vehicle 12 might leave working area 16, the external control device 14 operates braking system 24 remotely via wireless connection 38 and vehicle bus system 46.

[0042] Here, rail vehicle 12 is a hi-rail vehicle with a set of rail guidance wheels 42a, 42b and a set of road wheels 44a, 44b. Thus, rail vehicle 12 may be driven on rail track 18 as well as on a road (not depicted).

[0043] FIG. 2 depicts a second embodiment of a control system 10' according to the invention. Control system 10' comprises a rail vehicle 12' and an external control device 14'. Here, external control device 14' is a mobile device, namely a portable personal computer, which is removable from rail vehicle 12'. External control device 14' is arranged within rail vehicle 12' in order to operate rail vehicle 12' within the working area 16 of rail track 18. After operation of rail vehicle 12' the external control device 14' may be removed in its entirety from rail vehicle 12'.

[0044] Here, rail vehicle 12' is a track maintenance vehicle. Rail vehicle 12' has a propulsion engine 50, which is controlled by a driver (not depicted) of rail vehicle 12'. An end of train device 48 is detachably mounted to a rear end of rail vehicle 12'. End of train device 48 comprises a brake control unit 30'. Brake control unit 30' is connected to a brake line (brake pipe) 34' of a braking system 24'. Braking system 24' is a pneumatic braking system. It comprises front brakes 26 and rear brakes 28. In order to activate front brakes 26 and rear brakes 28 brake control unit 30' may release an air pressure from brake line 34'. External control device 14' is connected to end of train device 48 via a wireless connection 38'. Here, wireless connection 38' is a wireless local area network. Wireless connection 38' and end of train device 48 constitute an interface 52, which allows operably connecting external control device 14' with brake control unit 30'.

[0045] A GPS receiver 40' is provided with external control device 14'. External control device 14' is provided with information concerning an absolute position of external control device 14' and thus rail vehicle 12', aboard of which external control device 14' is located during operation, by GPS receiver 40'. External control device 14' determines the position of rail vehicle 12' within working area 16 from the absolute position and a known extension of working area 16. In order to control rail vehicle 12', external control device 14' can operate braking system

24' via end of train device 48.

[0046] FIG. 3 depicts a third embodiment of a control system 10" according to the invention. Control system 10" comprises an external device 14" and two rail vehicles 12'. Each rail vehicle 12' is equipped with an end of train device 48. Both rail vehicles 12' are being operated within a working area 16, which is defined on rail tracks 18. Working area 16 is monitored by external control device 14". External control device 14" was also employed to assign working area 16 to both rail vehicles 12'. Here, external control device 14" is a mobile device, which is temporarily positioned besides working area 16. External control device 14" is connected to both end of train devices 48 via a respective wireless connection 38', which is provided as a wireless local area network in this embodiment. Thus, external control device 14" may operate a braking system (not depicted) of either of said rail vehicles 12' by means of respective end of train device 48.

[0047] FIG. 4 depicts a flow chart of a method for controlling a rail vehicle according to the invention. In a step 100 an external control device is connected to an interface of the rail vehicle. In a step 102 an extension of a working area is determined by the external control device. Said working area is allocated to the rail vehicle in a step 104. Then, a period of operation 106 of the rail vehicle within said working area is executed, during which a driving condition of the rail vehicle is controlled by the external control device.

[0048] Operation 106 of the rail vehicle comprises the repeated and/or continuous execution of several steps. In a step 108 an absolute position of the rail vehicle is determined. The external control device compares the absolute position with the extension of the working area in a step 110, i.e. a distance of the rail vehicle from a boarder of the working area is determined. In a step 112 the external control device compares a driving condition of the rail vehicle with a set of admissible driving conditions. The driving condition may comprise the driving speed of the rail vehicle. Step 110 may be executed in parallel with step 112. Alternatively steps 110 and 112 may be executed consecutively in arbitrary order.

[0049] In a step 114 the external control device decides based on the results of steps 110 and 112 if an actuation of a braking system and/or a propulsion engine of the rail vehicle is necessary. If yes, the braking system and/or the propulsion engine are actuated by the external control device in a step 116. After actuation in step 116 the operation 106 is continued with step 108. Similarly, operation 106 is continued with step 108, if no actuation is found necessary in step 114.

[0050] FIG. 5 shows a schematic sketch of a railway network 54' with a one-dimensional route 60' for a rail vehicle 12" resulting in a Full-supervision Movement Authority according to the known European Train Control System (ETCS). The railway network 54' comprises several rail tracks 18'. The route 60', on which rail vehicle 12" may travel, is defined by a configuration of switches 62' on rail tracks 18'. Route 60' is depicted as a double

line. The control method according to ETCS prescribes a maximum travelling distance 64' for rail vehicle 12". Thus, route 60' is blocked for any other vehicle while rail vehicle 12" may travel along the route 60' for at most travelling distance 64'. Yet, rail vehicle 12" may not travel freely, i.e. back and forth, within a limited area of railway network 54'.

[0051] According to the invention a rail vehicle can be safely controlled not only along a one-dimensional route but within a two-dimensional working area. The extension of the working area can be determined in different ways.

[0052] FIG. 6 shows a schematic sketch of a railway network 54 comprising several rail tracks 18 with track elements 56, 57 (here: track sections). A working area 16 for a rail vehicle 12 is selected on basis of predefined track elements 56, 57; i.e. working area 16 is formed by selected track elements 56, while unselected track elements 57 are not part of working area 16. Track elements 56, which are part of the working area 16, are depicted with solid lines. Track elements 57, which do not belong to working area 16, are depicted with dashed lines. Rail vehicle 12 may freely travel within working area 16.

[0053] FIG. 7 shows a schematic sketch of the railway network 54 comprising several rail tracks 18 with end points 58, 59. The working area 16 for a rail vehicle 12 is selected on basis of predefined end points 58, 59. End points 58, which are selected to delimit working area 16 (active end points), are depicted as filled circles. End points 59, which are not active, are depicted as unfilled circles. Working area 16 is defined as the contiguous area of track sections 56' between selected end points 58. Track sections 56' within working area 16 are depicted with a solid line. Track sections 57' outside working area 16 are depicted with dashed lines.

[0054] In summary, the invention provides a simple and inexpensive way to prevent a rail vehicle from leaving a working area, which is reserved for said rail vehicle. For this purpose, an external control device is provided. In the first instance, the external control device serves to assign the working area to the rail vehicle. Furthermore, the external control device monitors the rail vehicle, while it is being maneuvered within the working area; i.e. the external control device receives position and speed data from the rail vehicle and compares this data with admissible values. Finally, the external control device automatically manipulates a driving condition of the rail vehicle, if the admissible driving conditions are violated. In particular, the external control device may actuate a braking system of the rail vehicle, in order to slow it down or to stop it, so as to prevent the rail vehicle from leaving the working area. The invention allows increasing operational safety of rail vehicles, which are not equipped with permanently installed safety and control means, as it is ensured that the rail vehicle stays within its private working area. Thus, the danger of collisions with other vehicles that might move outside the working area can be avoided. According to the invention, the amount of necessary wayside equipment can be reduced.

List of reference signs

[0055]

10; 10'; 10"	control system
12; 12'; 12"	rail vehicle
14; 14'; 14"	external control device
16	working area
18; 18'	rail track
20	facility
22	central antenna
24; 24'	braking system
26	front brake
28	rear brake
30; 30'	brake control unit
32	electronic control unit
34; 34'	brake line
36	vehicle antenna
38; 38'	wireless connection
39	interface
40; 40'	GPS receiver
42a, 42b	rail guidance wheels
44a, 44b	road wheels
46	vehicle bus system
48	end of train device
50	propulsion engine
52	interface
54	railway network
56, 57	track element
56', 57'	track section
58, 59	end point
60'	track line
62'	switch
64'	maximum travelling distance
100	connect external device to interface
102	determine extension of working area
104	allocate working area to rail vehicle
106	operate rail vehicle within working area
108	determine absolute position of rail vehicle
110	compare absolute position with extension of working area
112	compare driving condition with set of admissible driving conditions
114	criterion: actuation of braking system or propulsion engine required?
116	actuate braking system or propulsion engine

Claims

- Method for controlling a rail vehicle (12; 12'), in particular a hi-rail vehicle or a track maintenance vehicle or a shunting engine, within a working area (16)
 - wherein the working area (16) is allocated (104) to the rail vehicle (12; 12') by an external control device (14; 14'; 14"),

- wherein the external control device (14; 14'; 14") determines (110) the position of the rail vehicle (12; 12') within the working area (16), and
 - wherein the external control device (14; 14'; 14") controls a driving condition parameter of the rail vehicle (12; 12'), in order to prevent the rail vehicle (12; 12') from leaving the working area (16).

- Method according to claim 1, **characterized in that** the external control device (14; 14'; 14") controls the driving speed of the rail vehicle (12; 12').
- Method according to claim 1 or 2, **characterized in that** the external control device (14; 14'; 14") operates a braking system (24; 24') of the rail vehicle (12; 12').
- Method according to any one of the preceding claims, **characterized in that** the external control device (14; 14'; 14") determines (102) an extension of the working area (16).
- Method according to claim 4, **characterized in that** the external control device (14; 14'; 14") determines the extension of the working area (16) by choosing predefined track elements (56, 57) of a railway network (54).
- Method according to claim 4 or 5, **characterized in that** the external control device (14; 14'; 14") determines the extension of the working area (16) by choosing predefined end points (58, 59) to limit the working area (16).
- Method according to any one of the preceding claims, **characterized in that** the external control device (14; 14'; 14") is operated in a one channel safe procedure.
- Method according to any one of the preceding claims, **characterized in that** the external control device (14") controls a driving condition parameter of a further rail vehicle (12').
- Control system (10; 10'; 10") comprising a rail vehicle (12; 12') and an external control device (14; 14'; 14"), wherein the external control device (14; 14'; 14") is configured to allocate a working area (16) to the rail vehicle (12; 12'), wherein the external control device (14; 14'; 14") is configured to determine the position of the rail vehicle (12; 12') within the working area (16), and wherein an interface (39; 52) is provided to operably connect the external control device (14; 14'; 14") to a brake control unit (30; 30') of a braking system (24; 24') of the rail vehicle (12; 12').

10. Control system (10; 10'; 10") according to claim 9, **characterized in that** the rail vehicle (12; 12') has a hydraulic braking system (24) or a pneumatic braking system (24').
- 5
11. Control system (10) according to claim 9 or 10, **characterized in that** the interface (39) comprises a vehicle bus system (46), in particular a controller area network.
- 10
12. Control system (10; 10'; 10") according to any one of the claims 9 to 11, **characterized in that** the interface (39; 52) comprises a wireless connection (38; 38') between the external control device (14; 14'; 14") and the brake control unit (30; 30').
- 15
13. Control system (10'; 10") according to any one of the claims 9 to 12, **characterized in that** the brake control unit (30') is provided within a head of train device or within an end of train device (48).
- 20
14. Control system (10'; 10") according to any one of the claims 9 to 13, **characterized in that** the external control device (14'; 14") is a mobile device, in particular a portable personal computer.
- 25
15. Control system (10) according to any one of the claims 9 to 13, **characterized in that** the external control device (14) is a central computer.
- 30
16. Control system (10; 10'; 10") according to any one of the claims 9 to 15, **characterized in that** the rail vehicle (12; 12') is a hi-rail vehicle or a track maintenance vehicle or a shunting engine.
- 35
17. Use of an external control device (14; 14'; 14") for controlling a driving condition, in particular the driving speed, of a rail vehicle within (12; 12') a working area (16).
- 40

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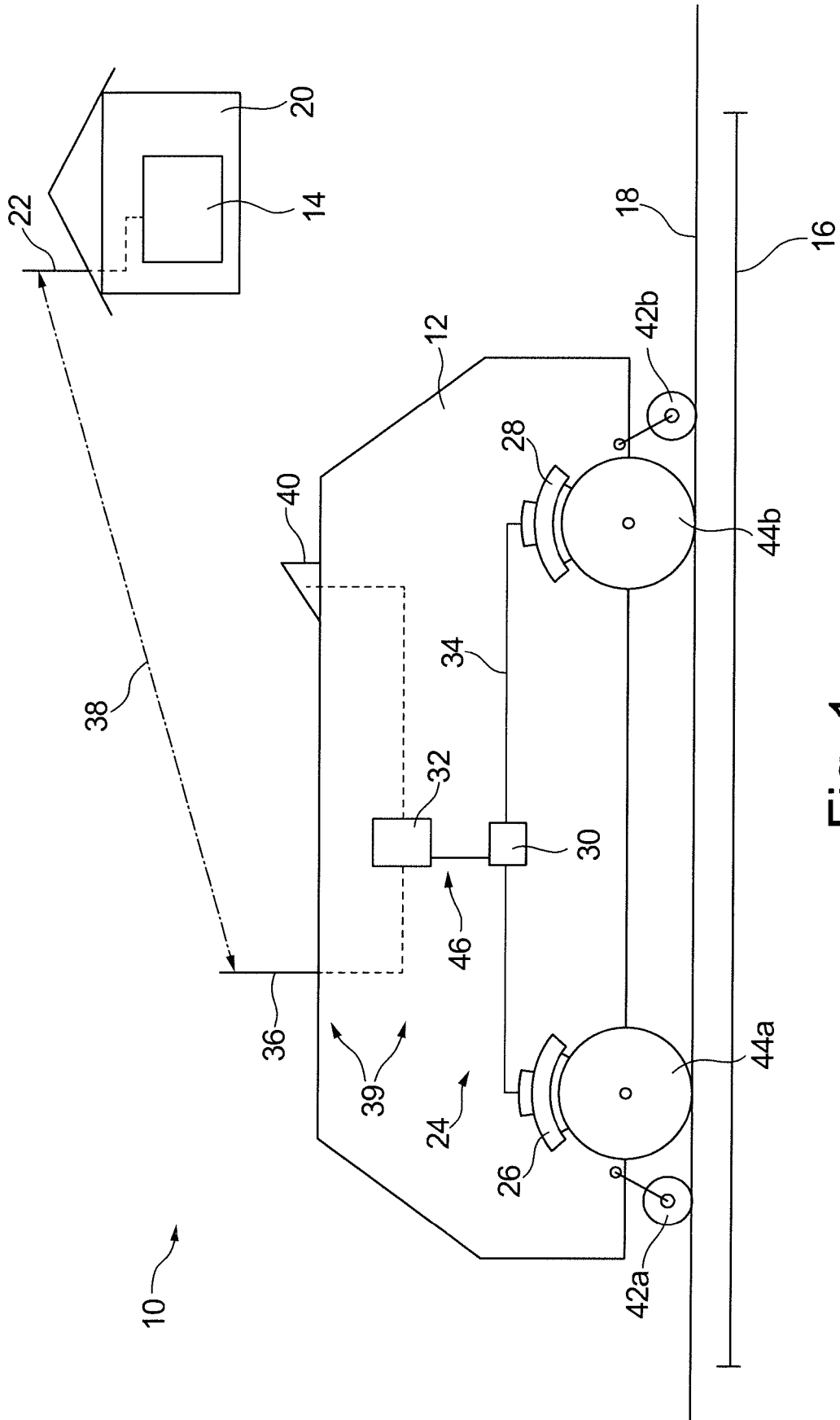


Fig. 1

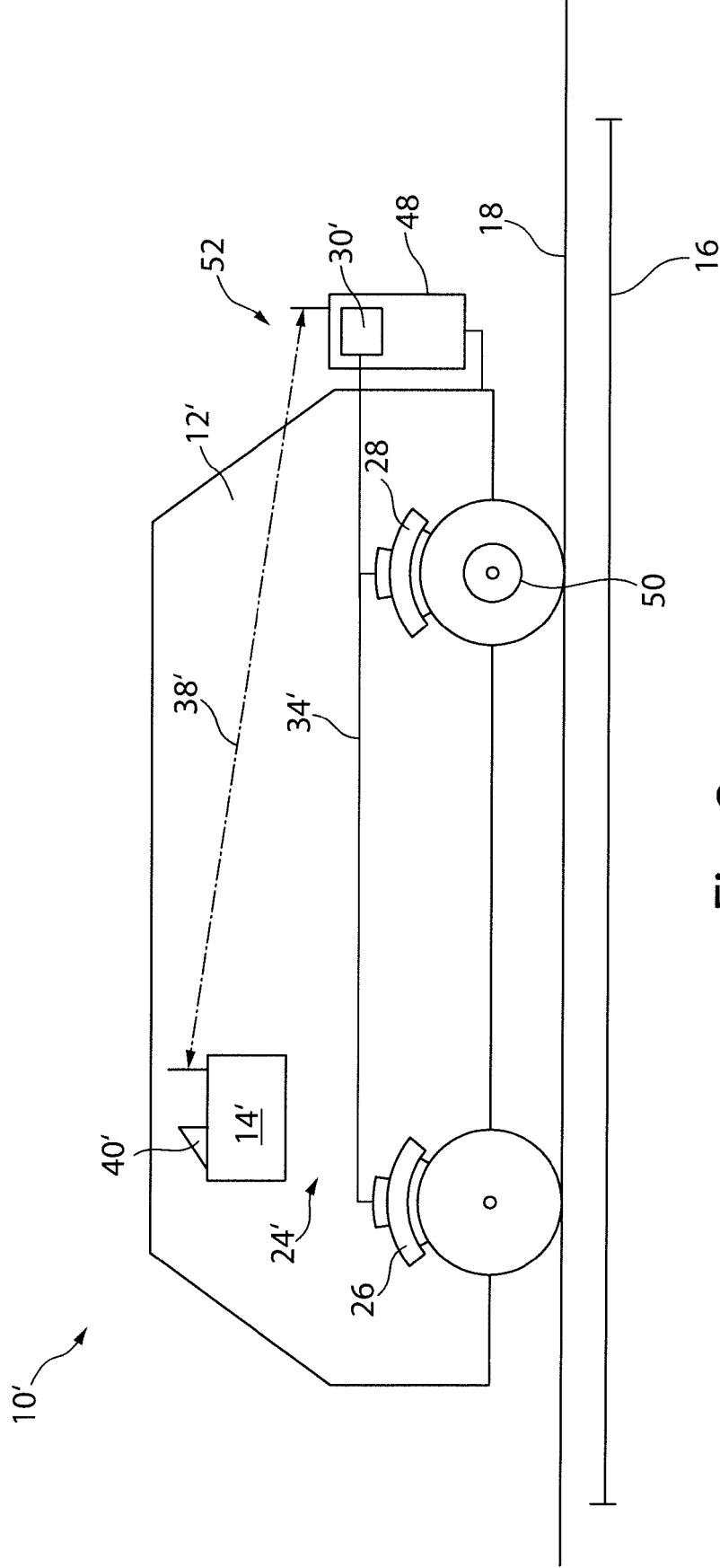


Fig. 2

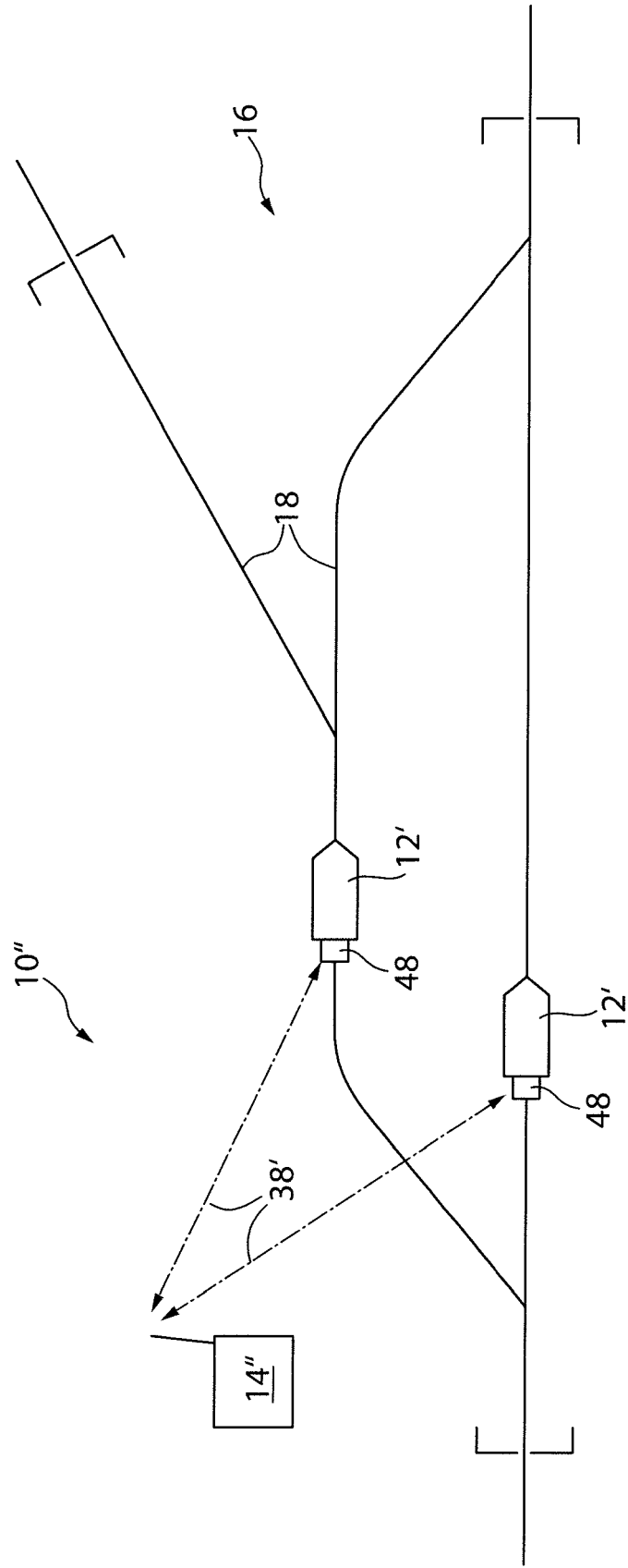


Fig. 3

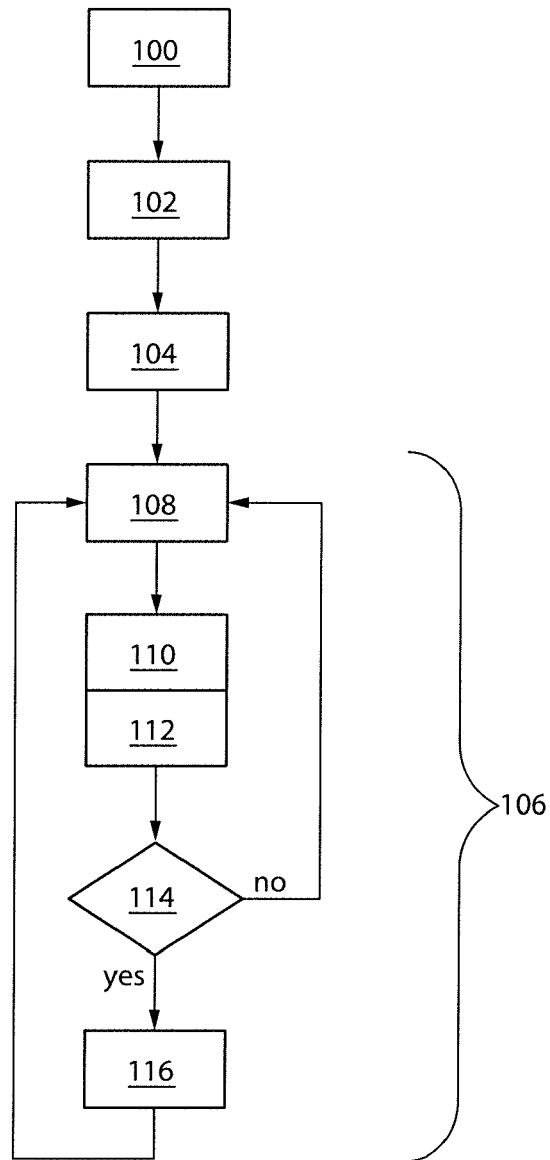


Fig. 4

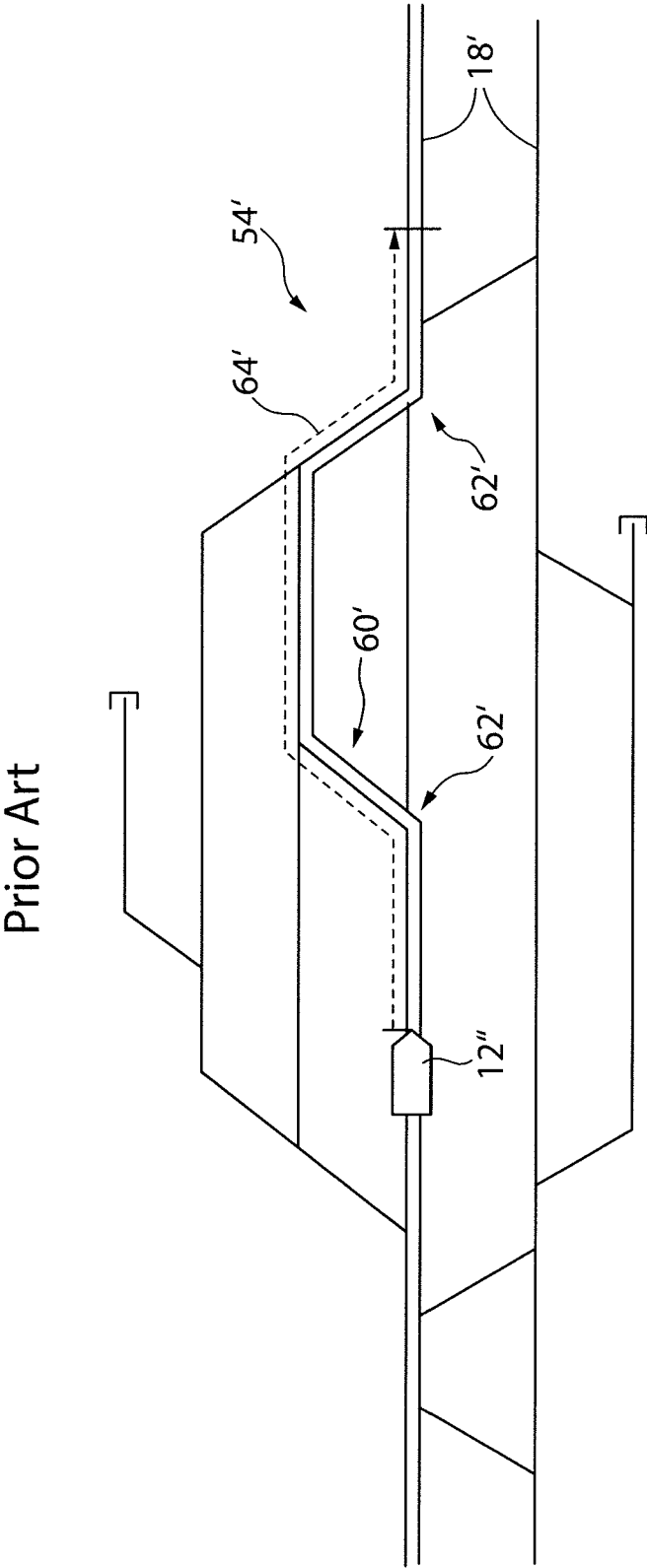


Fig. 5

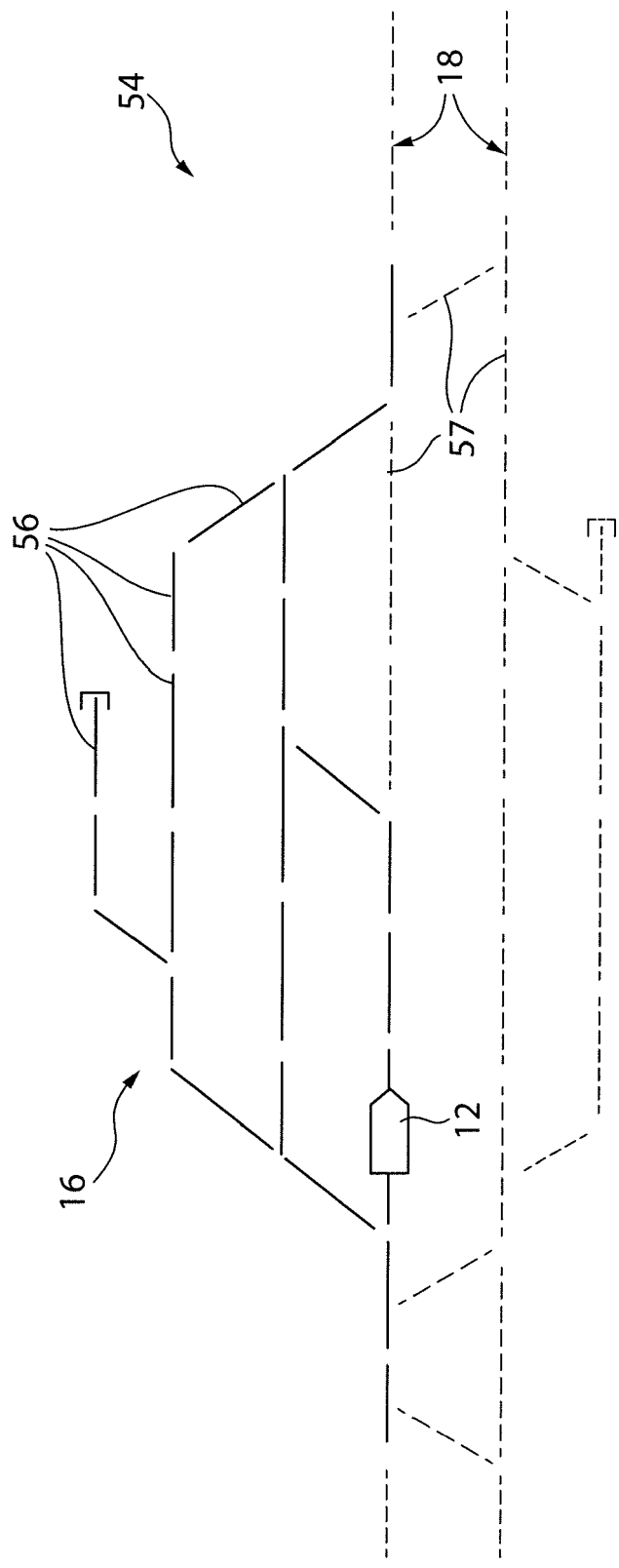


Fig. 6

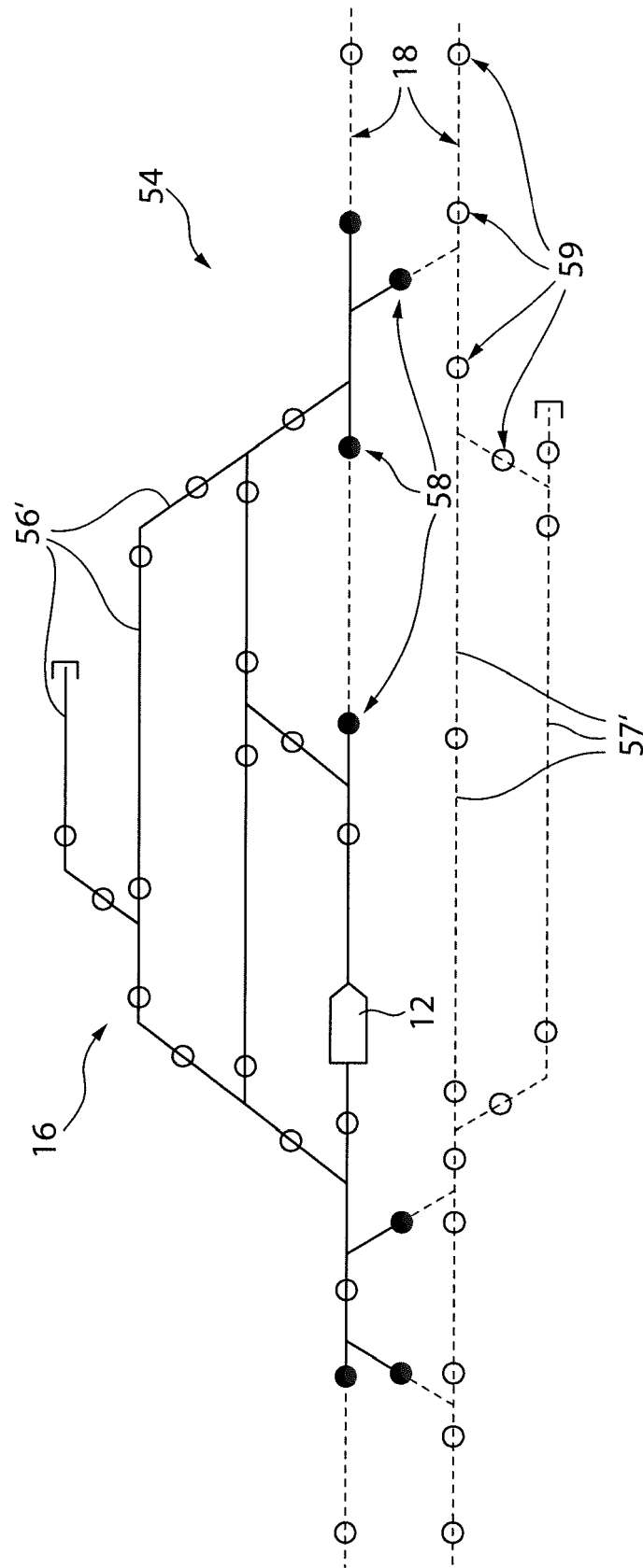


Fig. 7



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