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(54) **Decentralized interlocking**
Dezentralisierte Verriegelung
Inter-verrouillage décentralisé

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(73) Proprietors:
• **Siemens S.A.S.**
93200 St. Denis (FR)
• **Siemens Aktiengesellschaft**
80333 München (DE)

(72) Inventors:
• **Bohe, Armand Pierre**
92340 Bourg-la-Reine (FR)

- **El Fassi, Said**
91270 Vigneux sur Seine (FR)
- **Faubel, Peter**
38154 Königslutter (DE)
- **Paul, Uwe**
38855 Wernigerode (DE)
- **Windolf, Wolfgang**
38179 Schwülper (DE)

(74) Representative: **Maier, Daniel Oliver**
Siemens AG
Postfach 22 16 34
80506 München (DE)

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Description

[0001] The present invention concerns a method and an interlocking track device for managing an interlocking according to claims 1 and 7.

[0002] In particular, the present invention relates more generally to the management of train routes at interlocking areas and preventing conflicting train movements.

[0003] An interlocking is conventionally an arrangement of switch, lock and signal devices, i.e. a group of track devices, that is located where rail tracks cross, join, separate, and so on. Said devices are interconnected in such a way that their movements succeed each other in a predefined order, thereby preventing opposing or conflicting train movements and establishing a specific route for each train having to pass said interlocking. Said track devices are usually controlled by wayside interlocking control systems which are responsible for handling and managing the devices of the interlocking according to an interlocking logic and train movements while assuming train safety. Thus, the interlocking logic is at the basis of the management of the state of the interlocking, and thus of its devices. The document DE 195 26 159 C1 discloses de-centralised track-side interlocking devices in communication with trains for locking and release of routes in a railway network. The interlocking and the wayside interlocking control system are vital devices involved in the management of train routes at interlocking areas. Unfortunately, they are also complex devices requiring specific wiring architecture and the dispatching of interlocking data.

[0004] Consequently, there is a standing need for developing a simple, cost effective and efficient interlocking control system allowing train routes management.

[0005] It is therefore an objective of the present invention to provide a method and a system for managing an interlocking at an interlocking area in an efficient, flexible, cost effective way, having a simple architecture, and which avoid the above-mentioned problems.

[0006] This objective is achieved by an interlocking track device according to claim 7 and a method according to claim 1. In particular, the intelligent control system is able to control and command the interlocking track device so that its status, i.e. lock or release, over time is conformed to a time dependent status comprised in the reservation for the approaching guided vehicle.

[0007] The expression "guided vehicle" refers to a vehicle configured for following a guide or a succession of guides which determine at least one route for the guided vehicle. Said guide is for example a rail, or a line on the ground, or specific panels/signals defining a route for the guided vehicle, etc., and said guided vehicle is for example a train, a metro, a bus, a tram, or an automatic guided vehicle. The interlocking track device is a track device configured for establishing a route for an approaching guided vehicle. Typical track devices are switches, lock and signal track devices.

[0008] According to the present invention, each track

device of an interlocking an interlocking area is able to self-handle the management of its usage for a route for an approaching guided vehicle. In particular, the interlocking track device is able to handle several requests of several approaching guided vehicles at the same time. Therefore the interlocking track device itself is self-sufficient for determining its status (lock or release over time) in function of the received reservations and for handling a request of an approaching guided vehicle.

[0009] A reservation according to the invention comprises an identification of the approaching guided vehicle, a temporal starting point T1 and duration D1 for locking the interlocking track device from said temporal starting point T1 for said duration D1 for the approaching guided vehicle. In particular, said reservation comprises data for configuring the route at the interlocking area, and notably determining the status over time, i.e. lock or release, of each interlocking track device at said interlocking area and in function of said route.

[0010] Preferentially, the interlocking track device is autonomous in that it has its own intelligence through said intelligent control system for handling requests of approaching guided vehicles. It is for example also capable to communicate with another interlocking track device of said interlocking area for determining if the requested route defined at said interlocking area for the approaching guided vehicle is not conflicting with another route defined at the same interlocking area and requested by another approaching guided vehicle.

[0011] Preferentially, the method according to the invention comprises a cancellation of a recorded reservation for a specific approaching guided vehicle, and returning to said specific approaching guided vehicle a high priority message announcing said cancellation. For example, such a cancellation might be done if conflicted routes are detected at an interlocking area by the intelligent control system of the interlocking track device.

[0012] Preferentially, the command module of the intelligent control system is able to release the interlocking track device once the approaching guided vehicle passed said interlocking device. In particular, a reception of a message sent by the approaching guided vehicle once it passed the interlocking comprising said interlocking track device, or a verification performed by the interlocking track device that the approaching guided vehicle passed said interlocking, or both the reception and the verification, may activate the release of the interlocking track device by the command module. Therefore, the intelligent control system is capable of commanding the release of the route at the interlocking area once the approaching guided vehicle passed said interlocking, for instance upon reception of said message or upon detection that the guided vehicle passed the interlocking track device.

[0013] Preferentially, the communication device of the interlocking track device is wirelessly connectable to an approaching guided vehicle. Indeed, said communication device is in particular able to wirelessly and directly

communicate with an onboard communication device of a guided vehicle for directly receiving from said approaching guided vehicle said request for reservation, or for directly sending to the approaching guided vehicle a message configured for confirming or rejecting the request, or for directly sending to the approaching vehicle a high priority message for cancelling a reservation. Preferentially, temporally successive requests are treated by the interlocking track device in their temporal order of succession, i.e. in their order of reception at the wireless communication device, and/or according to a priority ranking. In particular, simultaneous requests are treated according to a priority ranking, and if they have a same rank of priority, according to a position of the approaching guided vehicle (3) compared to the position of the interlocking area (1), wherein the position refers to a geographic location.

[0014] Finally, the present invention is also related to a system for managing a route for a guided vehicle approaching an interlocking area, wherein the system comprises:

- an onboard control system configured for being mounted onboard said guided vehicle, said onboard control system being capable to wirelessly and remotely communicate with a wireless communication device of the interlocking track device as previously described, the onboard control system being further able to create and send a request to the wireless communication device for reserving said interlocking track device according to a predetermined route, which might be determined notably by said onboard control system, as well as a temporal starting point T1 and a duration D1 for locking the interlocking track device;
- said interlocking track device as previously described.

[0015] The present invention will be better understood through the following drawing:

Figure 1 schematic representation of an interlocking area comprising interlocking track devices according to the invention.

[0016] Figure 1 shows an interlocking area 1 comprising interlocking track devices 11, 12 according to the present invention, for example a switch 11 and a signal track device 12. The interlocking track device is configured for establishing and managing a route 4 for an approaching guided vehicle 3 which is approaching said interlocking area 1. Each interlocking track device 11, 12 according to the invention comprises:

- a wireless communication device 22 for remotely communicating with at least one guided vehicle, e.g. said approaching guided vehicle 3, and at least another interlocking track device belonging to said in-

terlocking area 1. The wireless communication device 22 is notably able to communicate with a communication device 211 or an onboard control system 21 of the approaching guided vehicle 3;

- an intelligent control system 23 configured for managing a request for reservation of the interlocking track device 11, 12 for the approaching guided vehicle 3, wherein said intelligent control system 23 is able to determine whether said reservation temporally overlaps with another reservation for another guided vehicle. Said request for reservation being for example sent by the communication device 211 of the onboard control system 21 of the approaching guided vehicle 3, wherein the onboard control system 21 is notably able to determine said route 4 for the guided vehicle 3 at each interlocking area 1 and to communicate with each interlocking track device 11, 12 data for establishing said route 4 at said interlocking area 1. The intelligent control system 23 comprises moreover a memory for recording the reservation if and only if no overlap is determined by the intelligent control system, and a command module configured for locking the interlocking track device according to each reservation recorded in said memory. The reservation comprises data for identifying the approaching guided vehicle 3, and temporal data, i.e. a temporal starting point T1 and a duration D1 indicating respectively from when the interlocking track device 11, 12 shall be locked and for which duration.

[0017] According to the present invention, if another guided vehicle requests the usage of the interlocking track device 11, 12, said interlocking track device 11, 12 will reject its request if there is some overlap in the time frame of the reservation recorded in its memory, or otherwise, will add the reservation to its memory. Finally, once the guided vehicle passed the interlocking track device 11, 12, said interlocking track device 11, 12 releases its status from locked to released, being thus ready for establishing a new route for a new approaching guided vehicle.

[0018] To summarize, the method and the interlocking track device according to the present invention have the following advantages:

- they make the interlocking track device self-sufficient and autonomous for handling request of approaching guided vehicles over time, wherein bidirectional communication between the guided vehicle and the interlocking track device allows to exchange data relative to the locking and release of the interlocking track device;
- they develop an architecture which facilitates the management of approaching guided vehicles at interlocking area;
- they allow a simple management of priority of approaching guided vehicles;

- they improve the efficiency of the interlocking track device;
- they allow a save of cost, notably by avoiding the use of a wayside/centralized interlocking logic and cabling;
- increased availability (if a device becomes unavailable because of a technical fault this unavailability remains local).

Claims

1. Method for establishing and managing a route (4) at an interlocking area (1) for an approaching guided vehicle (3), the interlocking area (1) comprising an interlocking track device (11) configured for exchanging data relative to its locking and releasing with the guided vehicle (3), the method comprising the steps of:

- a wireless reception by the interlocking track device (11) of a request for a reservation of the interlocking track device (11), wherein said reservation comprises a temporal starting point T1 and a duration D1 for locking the interlocking track device from said temporal starting point T1 for said duration D1, and wherein said request is remotely and wirelessly sent by the approaching guided vehicle (3);

- a determination whether a temporal overlap of said reservation with another reservation occurs, wherein said another reservation is recorded in a memory of the interlocking track device (11) and comprises another temporal starting point T2 and another duration D2, and

- if no overlap is determined, then recording said reservation in the memory and wirelessly confirming the reservation to the approaching guided vehicle (3),
 - if an overlap is determined, then returning to said approaching guided vehicle (3) a message rejecting its request; and

- a control/command of the interlocking track device (11) according to each recorded reservation for locking or releasing the interlocking track device (11).

2. Method according to claim 1, wherein said reservation comprises data for configuring the route (4) at the interlocking area (1).
3. Method according to one of the claims 1 or 2, comprising a cancellation of a recorded reservation for a specific approaching guided vehicle, and returning to said specific approaching guided vehicle a high priority message announcing said cancellation.

4. Method according to one of the claims 1 to 3, comprising a release of the interlocking track device (11) once said approaching guided vehicle (3) passed the interlocking.

5. Method according to one of the claims 1-4, wherein temporally successive requests are treated in their temporal order of succession and/or according to a priority ranking.

6. Method according to one of the claims 1-5, wherein simultaneous requests are treated according to a priority ranking and if they have a same rank of priority, according to a position of the approaching guided vehicle (3) compared to the position of the interlocking area (1).

7. Interlocking track device (11) configured for carrying out the method of claim 1 for establishing and managing a route (4) for an approaching guided vehicle (3) at an interlocking area (1), said interlocking track device (11) being configured for exchanging data relative to its locking and releasing with the guided vehicle (3), and comprising:

- a wireless communication device (22) for remotely communicating with at least one guided vehicle;

- an intelligent control system (23) configured for managing a request for reservation of the interlocking track device (11) for the approaching guided vehicle (3), wherein said intelligent control system (23) is able to determine whether said reservation temporally overlaps with another reservation, said intelligent control system comprising:

- a memory for recording said reservation if and only if no overlap has been determined;
 - a command module configured for locking the interlocking track device according to each reservation recorded in said memory

8. Interlocking track device (11) according to claim 7, wherein the command module of the intelligent control system (23) is able to release the interlocking track device (11) once the approaching guided vehicle (3) passed the interlocking.

9. Interlocking track device (11) according to one of the claims 7 or 8, wherein the communication device (22) of the interlocking track device (11) is wirelessly connectable to an approaching guided vehicle (3).

10. Interlocking track device (11) according to one of the claims 7-9, wherein the intelligent control system

(23) is capable of commanding the release of the route (4) at the interlocking area (1) once the approaching guided vehicle (3) passed said interlocking.

11. System for managing a route (4) for a guided vehicle (3) approaching an interlocking area (1), said system comprising:

- an onboard control system (21) configured for being mounted onboard said guided vehicle (3), said onboard control system (21) being capable to wirelessly and remotely communicate with a wireless communication device (22) of the interlocking track device (11) according to one of the claims 7-10, the onboard control system (21) being further able to create and send a request to said wireless communication device (22) for reserving said interlocking track device (11) according to a predetermined route (4);
- said interlocking track device (11) according to one of the claims 7-10.

Patentansprüche

1. Verfahren zum Einrichten und Verwalten einer Strecke (4) in einem Stellwerksbereich (1) für ein sich näherndes spurgebundenes Fahrzeug (3), wobei der Stellwerksbereich (1) eine Stellwerksgleisvorrichtung (11) umfasst, die zum Austauschen von Daten mit dem spurgebundenen Fahrzeug (3) bezüglich ihres Verschließens und ihres Auflösens konfiguriert ist, wobei das Verfahren folgende Schritte umfasst:

- drahtloses Empfangen einer Anforderung für eine Reservierung der Stellwerksgleisvorrichtung (11) durch die Stellwerksgleisvorrichtung (11), wobei die Reservierung einen zeitlichen Ausgangspunkt T1 und eine Dauer D1 für das Verschließen der Stellwerksgleisvorrichtung ab dem zeitlichen Ausgangspunkt T1 für die Dauer D1 umfasst und die Anforderung aus der Ferne und drahtlos von dem sich nähernden spurgebundenen Fahrzeug (3) gesendet wird,
- Ermitteln, ob es zu einer zeitlichen Überlappung der Reservierung mit einer anderen Reservierung kommt, wobei die andere Reservierung in einem Speicher der Stellwerksgleisvorrichtung (11) aufgezeichnet ist und einen anderen zeitlichen Ausgangspunkt T2 und eine andere Dauer D2 umfasst, und

- wenn keine Überlappung ermittelt wird, Aufzeichnen der Reservierung in dem Speicher und drahtloses Bestätigen der Reservierung für das sich nähernde spurgebun-

dene Fahrzeug (3),

- wenn eine Überlappung ermittelt wird, Antworten mit einer Nachricht für das sich nähernde spurgebundene Fahrzeug (3), in der dessen Anforderung abgelehnt wird, und

- Steuern/Anweisen der Stellwerksgleisvorrichtung (11) gemäß jeder aufgezeichneten Reservierung zum Verschließen oder Auflösen der Stellwerksgleisvorrichtung (11).

2. Verfahren nach Anspruch 1, wobei die Reservierung Daten zum Konfigurieren der Strecke (4) im Stellwerksbereich (1) umfasst.

3. Verfahren nach einem der Ansprüche 1 und 2, das eine Rücknahme einer aufgezeichneten Reservierung für ein bestimmtes sich näherndes spurgebundenes Fahrzeug und ein Antworten mit einer Nachricht von hoher Priorität für das bestimmte sich nähernde spurgebundene Fahrzeug umfasst, in der die Rücknahme bekanntgegeben wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, das eine Auflösung der Stellwerksgleisvorrichtung (11) umfasst, sobald das sich nähernde spurgebundene Fahrzeug (3) das Stellwerk passiert hat.

5. Verfahren nach einem der Ansprüche 1 bis 4, wobei zeitlich aufeinanderfolgende Anforderungen in ihrer zeitlichen Reihenfolge und/oder entsprechend einer Prioritätsabstufung verarbeitet werden.

6. Verfahren nach einem der Ansprüche 1 bis 5, wobei gleichzeitige Anforderungen entsprechend einer Prioritätsabstufung und, wenn sie die gleiche Prioritätsstufe aufweisen, entsprechend einer Position des sich nähernden spurgebundenen Fahrzeugs (3) in Bezug auf die Position des Stellwerksbereichs (1) verarbeitet werden.

7. Stellwerksgleisvorrichtung (11), die zum Ausführen des Verfahrens nach Anspruch 1 zum Einrichten und Verwalten einer Strecke (4) in einem Stellwerksbereich (1) für ein sich näherndes spurgebundenes Fahrzeug (3) konfiguriert ist, wobei die Stellwerksgleisvorrichtung (11) zum Austauschen von Daten mit dem spurgebundenen Fahrzeug (3) bezüglich ihres Verschließens und ihres Auflösens konfiguriert ist und Folgendes umfasst:

- eine Drahtloskommunikationsvorrichtung (22) für die Fernkommunikation mit mindestens einem spurgebundenen Fahrzeug,

- ein intelligentes Leitsystem (23), das zum Verwalten einer Anforderung für eine Reservierung der Stellwerksgleisvorrichtung (11) für das sich nähernde spurgebundene Fahrzeug (3) konfi-

guriert ist, wobei das intelligente Leitsystem (23) in der Lage ist zu ermitteln, ob sich die Reservierung zeitlich mit einer anderen Reservierung überlappt, wobei das intelligente Leitsystem Folgendes umfasst:

- einen Speicher zum Aufzeichnen der Reservierung nur dann, wenn keine Überlappung ermittelt worden ist,
- ein Befehlsmodul, das zum Verschließen der Stellwerksgleisvorrichtung entsprechend jeder in dem Speicher aufgezeichneten Reservierung konfiguriert ist.

8. Stellwerksgleisvorrichtung (11) nach Anspruch 7, wobei das Befehlsmodul des intelligenten Leitsystems (23) in der Lage ist, die Stellwerksgleisvorrichtung (11) aufzulösen, sobald das sich nähernde spurgebundene Fahrzeug (3) das Stellwerk passiert hat.
9. Stellwerksgleisvorrichtung (11) nach einem der Ansprüche 7 und 8, wobei die Kommunikationsvorrichtung (22) der Stellwerksgleisvorrichtung (11) drahtlos mit einem sich nähernden spurgebundenen Fahrzeug (3) verbunden werden kann.
10. Stellwerksgleisvorrichtung (11) nach einem der Ansprüche 7 bis 9, wobei das intelligente Leitsystem (23) in der Lage ist, die Freigabe der Strecke (4) im Stellwerksbereich (1) zu befehlen, sobald das sich nähernde spurgebundene Fahrzeug (3) das Stellwerk passiert hat.
11. System zum Verwalten einer Strecke (4) für ein spurgebundenes Fahrzeug (3), das sich einem Stellwerksbereich (1) nähert, wobei das System Folgendes umfasst:
 - ein Fahrzeugsteuersystem (21), das für die Installation in dem spurgebundenen Fahrzeug (3) konfiguriert ist, wobei das Fahrzeugsteuersystem (21) in der Lage ist, drahtlos und aus der Ferne mit einer Drahtloskommunikationsvorrichtung (22) der Stellwerksgleisvorrichtung (11) nach einem der Ansprüche 7 bis 10 zu kommunizieren, wobei das Fahrzeugsteuersystem (21) ferner in der Lage ist, eine Anforderung zum Reservieren der Stellwerksgleisvorrichtung (11) entsprechend einer vorgegebenen Strecke (4) zu erstellen und zu der Drahtloskommunikationsvorrichtung (22) zu senden,
 - die Stellwerksgleisvorrichtung (11) nach einem der Ansprüche 7 bis 10.

Revendications

1. Procédé pour établir et gérer un itinéraire de cheminement (4) au niveau d'une zone d'interverrouillage (1) pour un véhicule guidé (3) qui s'approche, la zone d'interverrouillage (1) comprenant un dispositif d'interverrouillage de voie (11) qui est configuré pour échanger des données en relation avec son verrouillage et sa libération avec le véhicule guidé (3), le procédé comprenant les étapes qui sont constituées par :
 - une réception sans fil par le dispositif d'interverrouillage de voie (11) d'une requête pour une réservation du dispositif d'interverrouillage de voie (11), dans lequel ladite réservation comprend un point de début temporel T1 et une durée D1 pour verrouiller le dispositif d'interverrouillage de voie depuis ledit point de début temporel T1 pendant ladite durée D1, et dans lequel ladite requête est envoyée à distance et sans fil par le véhicule guidé (3) qui s'approche ;
 - une détermination de si oui ou non un chevauchement temporel de ladite réservation avec une autre réservation est observé, dans lequel ladite autre réservation est enregistrée dans une mémoire du dispositif d'interverrouillage de voie (11) et comprend un autre point de début temporel T2 et une autre durée D2 ; et
 - si aucun chevauchement n'est déterminé, alors l'enregistrement de ladite réservation dans la mémoire et la confirmation sans fil de la réservation au véhicule guidé (3) qui s'approche ;
 - si un chevauchement est déterminé, alors le retour audit véhicule guidé (3) qui s'approche d'un message qui rejette sa requête ; et
 - un contrôle/une commande du dispositif d'interverrouillage de voie (11) conformément à chaque réservation enregistrée pour verrouiller ou libérer le dispositif d'interverrouillage de voie (11).
2. Procédé selon la revendication 1, dans lequel ladite réservation comprend des données pour configurer l'itinéraire de cheminement (4) au niveau de la zone d'interverrouillage (1).
3. Procédé selon l'une des revendications 1 ou 2, comprenant une annulation d'une réservation enregistrée pour un véhicule guidé qui s'approche spécifique, et le retour audit véhicule guidé qui s'approche spécifique d'un message de priorité élevée qui annonce ladite annulation.

4. Procédé selon l'une des revendications 1 à 3, comprenant une libération du dispositif d'interverrouillage de voie (11) une fois que ledit véhicule guidé (3) qui s'approche a passé l'interverrouillage.
5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel des requêtes successives temporellement sont traitées selon leur ordre temporel de succession et/ou conformément à un classement en termes de priorité.
6. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel des requêtes simultanées sont traitées conformément à un classement en termes de priorité et si elles présentent un même rang de priorité, conformément à une position du véhicule guidé (3) qui s'approche par comparaison avec la position de la zone d'interverrouillage (1).
7. Dispositif d'interverrouillage de voie (11) configuré pour mettre en oeuvre le procédé selon la revendication 1 pour établir et gérer un itinéraire de cheminement (4) pour un véhicule guidé (3) qui s'approche au niveau d'une zone d'interverrouillage (1), ledit dispositif d'interverrouillage de voie (11) étant configuré pour échanger des données en relation avec son verrouillage et sa libération avec le véhicule guidé (3), et comprenant :
- un dispositif de communication sans fil (22) pour communiquer à distance avec au moins un véhicule guidé ;
 - un système de commande intelligent (23) configuré pour gérer une requête de réservation du dispositif d'interverrouillage de voie (11) pour le véhicule guidé (3) qui s'approche, dans lequel ledit système de commande intelligent (23) dispose de la capacité de déterminer si oui ou non ladite réservation chevauche temporellement une autre réservation, ledit système de commande intelligent comprenant :
 - une mémoire pour enregistrer ladite réservation si et seulement si aucun chevauchement n'a été déterminé ;
 - un module de commande configuré pour verrouiller le dispositif d'interverrouillage de voie conformément à chaque réservation enregistrée dans ladite mémoire.
8. Dispositif d'interverrouillage de voie (11) selon la revendication 7, dans lequel le module de commande du système de commande intelligent (23) dispose de la capacité de libérer le dispositif d'interverrouillage de voie (11) une fois que le véhicule guidé (3) qui s'approche a passé l'interverrouillage.
9. Dispositif d'interverrouillage de voie (11) selon l'une des revendications 7 ou 8, dans lequel le dispositif de communication (22) du dispositif d'interverrouillage de voie (11) peut être connecté sans fil à un véhicule guidé (3) qui s'approche.
10. Dispositif d'interverrouillage de voie (11) selon l'une des revendications 7 à 9, dans lequel le système de commande intelligent (23) dispose de la capacité de commander la libération de l'itinéraire de cheminement (4) au niveau de la zone d'interverrouillage (1) une fois que le véhicule guidé (3) qui s'approche a passé ledit interverrouillage.
11. Système pour gérer un itinéraire de cheminement (4) pour un véhicule guidé (3) qui s'approche d'une zone d'interverrouillage (1), ledit système comprenant :
- un système de commande embarqué (21) configuré pour être monté à bord dudit véhicule guidé (3), ledit système de commande embarqué (21) disposant de la capacité de communiquer sans fil et à distance avec un dispositif de communication sans fil (22) du dispositif d'interverrouillage de voie (11) selon l'une des revendications 7 à 10, le système de commande embarqué (21) disposant en outre de la capacité de créer et d'envoyer une requête audit dispositif de communication sans fil (22) pour réserver ledit dispositif d'interverrouillage de voie (11) conformément à un itinéraire de cheminement prédéterminé (4) ;
 - ledit dispositif d'interverrouillage de voie (11) selon l'une des revendications 7 à 10.

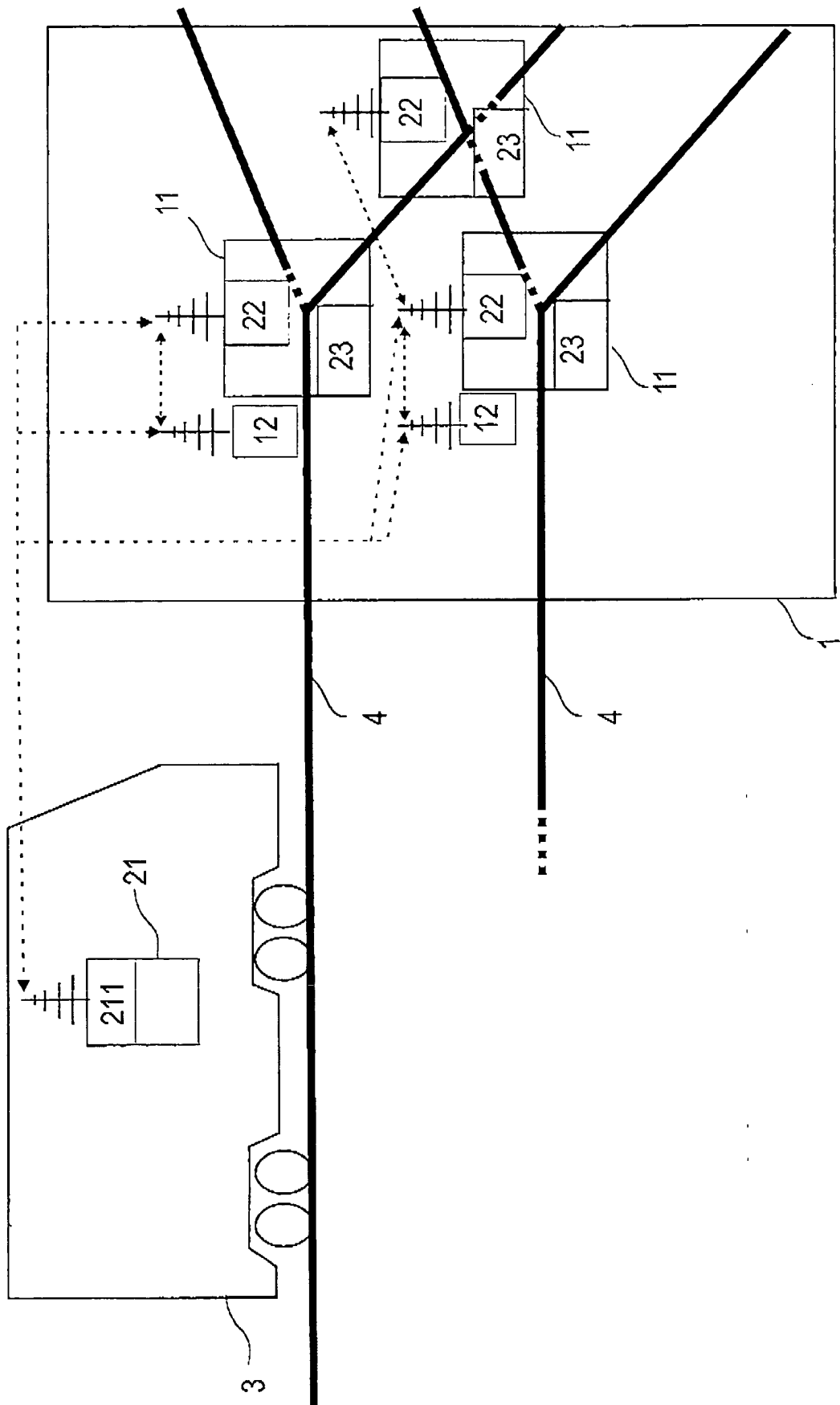


FIG 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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