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(54) **System for detecting the presence of an approaching train in a track section**

(57) The invention relates to a system for detecting the presence of an approaching train in a track section.

In the field of track safety a large number of applications for realising safer working conditions for rail track workers carrying out work on the track are known. The object of the invention is to provide a system for protecting a track section, which obviates the need to take a track section out of service for a shorter or longer period of time during which said track section cannot be used for rail traffic.

According to the invention, the system is **characterised in that** it comprises at least one transmission unit, which can be brought into electrical contact with a first rail, as well as at least one receiving unit, which can be brought into electrical contact with the other rail, said transmission unit being designed for emitting at least one characteristic signal via the first rail in use and said receiving unit being designed for receiving said characteristic signal via the other rail as a result of a short-circuit bridge between the two rails realised by the wheel axle of the approaching train, the system being designed to deliver at least one alerting signal upon receipt of the aforesaid signal.

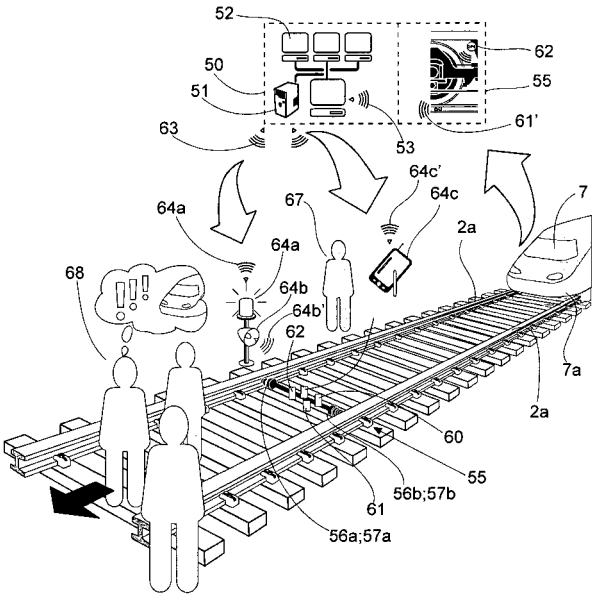

Fig. 3

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Description

[0001] The invention relates to a system for detecting the presence of an approaching train in a track section.

[0002] In the field of track safety a large number of applications for realising safer working conditions for rail track workers carrying out work on the track are known.

[0003] From Dutch patent NL 1033077 there is known a so-called short-circuit link. When work is to be carried out in a track section, it is usual to install a short-circuit bridge between the rails of the section in question, thus simulating the presence of a train in said track section. As a result, the railway safety system of the track section in question will be activated and the track signals will turn to red. This is called the "taking out of service" of the track section.

[0004] A drawback of such a short-circuit link is the fact that, when used, the track section in question is completely taken out of service for a shorter or longer period of time, so that it cannot be used for rail traffic. Given the increasing intensity of the rail traffic and the associated need for a more efficient utilization of the rail infrastructure, taking a track section out of service for the purpose of carrying out work is found to be more and more problematic.

[0005] Accordingly it is an object of the present invention to provide a solution to the above problem, which obviates the need to take a track section out of service for a shorter or longer period of time during which said track section cannot be used for rail traffic.

[0006] According to the invention, the system is to that end **characterised in that** it comprises at least one transmission unit, which can be brought into electrical contact with a first rail, as well as at least one receiving unit, which can be brought into electrical contact with the other rail, said transmission unit being designed for emitting at least one characteristic signal via the first rail in use and said receiving unit being designed for receiving said characteristic signal via the other rail as a result of a short-circuit bridge between the two rails realised by the wheel axle of the approaching train, the system being designed to deliver at least one warning signal upon receipt of the aforesaid signal.

[0007] When such a technical solution is used, there is no need to take the track section in question out of service. In fact, the track section will remain available for rail traffic and the system will alert the track workers who are working in the track section in question that a train is approaching the track section.

[0008] According to one embodiment, the transmission unit and the receiving unit form part of a frame that can be disposed between the first rail and the other rail. This makes it possible to place the system in the track section in a simple and reliable manner, which increases the usability of the system.

[0009] More specifically, the frame comprises at least two electrically separated frame arms, which frame arms can each be individually brought into contact with a rail. In this way a reliable set-up is realized, thus minimizing the risk of failure of the signaling system according to the invention.

[0010] According to a special embodiment, the frame arms may be pivotally interconnected. This leads to a manageable system, which is compact and easy to install and remove.

[0011] According to another functional embodiment, the frame also comprises communication means for generating an activation signal in dependence on the receipt of said characteristic signal and delivering said activation signal to a central processing unit forming part of the system.

[0012] Said central processing unit may be designed for generating at least one alerting signal in dependence on said activation signal and delivering said alerting signal to one or more alerting means.

[0013] In this way the system realizes an adequate protection of the track section, in particular if the track section to be protected is situated at a very remote location, for example in a railway yard. Thus it is possible to monitor one or more track sections from a (large) distance, using several frames according to the invention, so that the system can be used for a various applications.

[0014] More specifically, said alerting means may comprise at least one acoustic signal generating device or at least one optical signal generating device. Furthermore, the alerting means may comprise at least one wireless receiver to enable communication and signal exchange between the various parts of the system which are located (far) apart.

[0015] In another specific embodiment, the system according to the invention is **characterized in that** the frame comprises at least one vibration sensor. This makes it possible to detect the passage of the train over the signaling frame not only on the basis of the detection of a short-circuit caused by the wheel axle of the approaching train but also on the basis of vibrations.

[0016] According to another detection method to be used for detecting the approach, and more specifically the passage of a train, the signaling frame is provided with at least one induction sensor. Using said induction sensor, it is possible to detect the passage of a train (a large object of metal or steel) on the basis of an induction current generated by or in the induction sensor, which induction current results in the generation and emission of the activation signal.

[0017] According to the invention, in order to achieve an adequate determination of the position of the track section to be protected, the frame may comprise a GPS module.

[0018] Furthermore, the transmission unit comprises a GPRS module to enable wireless communication between the parts of the system.

[0019] A more versatile application is **characterized in that** the central processing unit is designed for receiving, storing and processing several activation signals from different transmission units and delivering alerting

signals to the corresponding alerting means.

[0020] The invention also relates to a signaling frame as used in a system according to the invention.

[0021] The invention will now be explained in more detail with reference to a drawing. In the drawing:

Figures 1 a and 1b are plan views of a track section protected by a railway safety system;
Figure 2 schematically shows a detection device according to the prior art;
Figure 3 schematically shows an embodiment of a system according to the invention;
Figure 4 shows an embodiment of a signaling frame for use in a system according to the invention.

[0022] For a better understanding of the invention, like parts will be indicated by identical numerals in the description of the figures below.

[0023] Figure 1 a shows a railway 1 built up of successive track sections 1. $_1$-1_0-1_{+1} etc. The track, which comprises several track sections, is built up of rails 2a-2b, which are fixed to sleepers 3. The successive track sections are separated from each other by means of insulating connecting bridges 4 provided in one of the rails 2a-2b or, as shown in the figure, in both rails.

[0024] Each track section 1_{-1}-1_0-1_{+1} is provided with a track circuit, by means of which the presence of a train in the section in question can be detected. To that end the track circuit of each track section is built up of an AC voltage source 5, which is connected to each rail 2a, 2b by means of connections 5a, 5b, respectively. On the other side of the track section in question a dropout or track relay 6 is provided, which is likewise electrically connected to the two rails 2a, 2b of the section in question by means of connections 6a, 6b, respectively.

[0025] In the situation shown in figure 1a, no train is present in the track section 1_0, which means that the AC voltage applied across the two rails 2a-2b (by the AC voltage source 5) keeps the (magnetic) relay 6 energized and open. This situation means that the track signals associated with the track section in question are green and that the track safety system allows trains to enter said track section 1_0.

[0026] Figure 1b shows the situation in which a train 7 enters the track section 1_0 from the left. The axles 7a of the train create a short-circuit between the two rails 2a-2b, causing current to flow from the AC voltage source 5, via the connection 5a, the rail 2a, the axles 7a and via the other rail 2b and the connection 5b back to the AC voltage source. As a result, less current will flow to the track relay 6, causing it to drop out. This situation is shown in figure 1 b.

[0027] Said dropping out of the track relay 6 resulting from the short-circuit created across the two rails 2a-2b will cause the track signals associated with the track section 1_0 in question to change to red. Turning the track signals to red means that the track section in question is protected and for the time being inaccessible to subsequently arriving trains.

[0028] When work is being carried out in the track section in question, such short-circuiting of the track section 1_0 by a passing train 7 can also be simulated by a "simulation train", using a short-circuit link, a prior art embodiment of which is shown in figure 2. The prior art short-circuit link 10 is built up of a housing 10a, to which two arms 11-31 are connected, whose contact heads 17-37 can be brought into electrical contact with the respective rails 2a-2b. The two arms 11-31 can be moved apart by means of a lever 10b so as to effect a good clamping engagement and thus a good electrical contact between the contact heads 17-37 and the two rails 2a-2b. The short-circuit thus realized between the two rails 2a-2b can be detected or monitored by means of suitable detection means 15, in this embodiment in the form of a separate unit, which is connected to each contact head 17-37 by means of connections 15a and 15b, respectively.

[0029] The short-circuit link 10 as shown in figure 2 has a number of drawbacks, the most important being the single contact between the two arms 11-31 and the rails 2a-2b. Apart from the fact that the electrical contact between the two arms 11-31 and the respective rails 2a-2b cannot be adequately realized and ensured at all times, the prior art short-circuit link has another significant drawback in use.

[0030] After all, the consequence of the placement of such a short-circuit link is that the rail safety system of the track section in question is activated and the track signal will turn to red.

[0031] Said taking the track section out of service leads to the track section in question being taken completely out of service for a shorter or longer period of time, so that it cannot be used for rail traffic. Given the constantly increasing intensification of the rail traffic and the associated need for a more efficient utilization of the rail infrastructure, taking a track section out of service for the purpose of carrying out work is increasingly found to be problematic.

[0032] Figure 3 shows an embodiment of a system for detecting an approaching train in a track section by which the drawback of taking the track section in question out of service is avoided.

[0033] The system according to the invention is indicated by reference numeral 50 and comprises a central processing unit 51, which may comprise a central storage unit, for example, and which is connected to one or more work stations 52. The central processing unit 51 and the work stations are disposed elsewhere, preferably at a permanent location, and function as a central processing point for the incoming signals from several so-called signaling frames 55. Each signaling frame 55 is placed in a section 1_0 of a railway 1 and functions to protect the section in question. An embodiment of such a signaling frame is shown in figure 4.

[0034] In a preferred embodiment, each signaling frame 55 is made up of two pivotally interconnected frame

arms 56a-56b. Each frame arm 56a-56b is provided with a contact point 57a-57b, which can each be brought into electrical contact with one of the rails 2a-2b.

[0035] It should be noted that the arms 56a-56b are electrically separated, as is indicated by reference numeral 58.

[0036] The signaling frame 55 is provided with a transmission unit 59, which is designed to transmit a characteristic signal through the first rail 2a in use. The signaling unit 55 is furthermore provided with a receiving unit 60, which is preferably present on or in the other frame arm 56b, for receiving said characteristic signal via the other rail 2b.

[0037] The receiving unit 60 will receive said characteristic signal via the other rail 2b when an approaching train 7 approaches or enters the track section in question and thus electrically connects the first rail 2a to the other rail 2b via the short-circuit bridge realized by the wheel axle 7a. As a result, the characteristic signal emitted by the transmission unit 59 via the first rail 2a will flow back towards the signaling frame 55 (in particular the frame arm 57b and the receiving unit 60) via the wheel axle 7a and through the second rail 2b.

[0038] The invention functions to communicate the detection of an approaching train 70 to the central processing unit 51-52.

[0039] Each signaling frame 55 is to that end provided with suitable communication means 61, for example a GSM or GPRS communication means, which communicate the detection of the approaching crane 7, which has been made possible by the short-circuit bridge realized between the two rails 2a and 2b, to the central processing unit 51-52. The central processing unit 51-52 is to that end provided with suitable receiving means 53, which receive and process the signals 61' emitted by the communication means 61 of the signaling frame 55.

[0040] Usually, the specific communication signal 61' comprises information about the identity of the signaling frame 55 so as to make easy identification of the signaling frame 55 in question by the central processing unit 51-52 possible. Each signaling frame 55 may also be provided with a so-called GPS module 62, so that not only the identity of the signaling frame 55 in question but also its current geographic location will be contained in the communication signal 61' emitted by the communication means 61.

[0041] This enables easy identification and localization of the signaling frame 55 in question, said localization in particular concerning the exact location of the signaling frame 55 in the railway track.

[0042] The detection of the approaching train 7 and the receipt of the specific activation signal 61' by the central processing unit 51-52 results in the delivery of an alerting signal 63, which is received by specific alerting means 64a-64b-64c associated with the signaling frame 55 in question.

[0043] The alerting means 64a-64b-64c in question are associated with the signaling frame 55 that monitors a specific track section 1_0 or connected to the frame 55 in question in a technically different manner. The alerting means may consist of an optical signal generating device 64a or an acoustic signal generating device 64b. The alerting means may also comprise a mobile device 64c, such as a mobile telephone worn on the body by a track worker 67 carrying out work at the location of the track section 1_0 in question.

[0044] The alerting signal 63 delivered by the signal processing unit 51-52 in response to the receipt of the activation signal 61' delivered by the signally frame 55 causes the alerting means 64a-64b-64c etc to generate a warning signal 64a'-64b'-64c', which alerts the track workers 67-68 carrying out work in the track section in question to the approach of the train 7.

[0045] The various warning signals alert the workers 67-68 to the fact that they must leave the track section 1_0 in time.

[0046] Using the present invention, there is no need to take a track section entirely out of service, in contrast to the situation in which the known short-circuit link is used.

[0047] On the contrary, the track section in question continuous to be available for rail traffic, and consequently a train 7 can normally approach said track section. The associated rail signals will not be on red but on green, thereby clearing the track section in question for the approaching train. In such a situation the train 7 will normally continue on its way and not be stopped by means of an emergency stop. The alerting means 64a-64c thus function to alert the track workers 67-68 to the fact that a train is approaching and that they must leave the track section.

[0048] Although this would appear to be a less safe solution, the system according to the invention does have the advantage that the track section in question is not taken out of service for a shorter or longer period of time, which may be desirable if the work will not last long and is to be carried out in a track section that is used intensively.

[0049] The system according to the invention is also quite suitable for use at large railway yards, where the taking out of service of a track section frequently renders the entire railway yard unserviceable. By using a system according to the invention, the railway yard or the track section where the work is to be carried out will remain available for rail traffic. The regular rail traffic can continue and the track workers will be warned or alerted in time to the approach of the train 7.

[0050] In addition to information regarding the identity of the signaling frame 55 in question, the data as processed in the activation signal 61' also contain information regarding the exact location (as obtained by the GPS module 62) as well as information regarding specific operating parameters of the signaling frame 55. Think in this connection of internal power supply values etc.

[0051] The characteristic signal that is imposed on the first rail 2a provides information regarding the availability, reliability and accessibility of the signaling system. If for

some reason or other the signal being transmitted through the rail 2a is lost or received in distorted form by the receiving unit 60, the system 50 will interpret this as a malfunction in the alerting system. In response thereto, the system will automatically turn to a so-called fail-safe mode. This may lead to the central data unit 51-52 generating an alerting signal 63 for the associated alerting means, so that the track workers 67-68 present in the track section are directly alerted, in this case to the possible unsafe functioning of the signaling frame 55 in question (and the unsafety of the associated track section).

[0052] On the one hand this means that the track workers 67-68 must directly leave the track section in question, because the safety of the section can no longer be guaranteed, whilst on the other hand the signaling frame 55 can be controlled by remote control to actively provide a short-circuit bridge between the two rails 2a-2b, thus actively taking the track section 1_0 in question out of service, as in the prior art.

[0053] The frame 55 may to that end be provided with an electric circuit, which, possibly provided with a relay connection, realizes a short-circuit between the two rails 2a-2b and thus takes the track section 1_0 out of surface and turns the signals to red. In such a situation an approaching train 7 can no longer enter the track section in question, because otherwise the automatic emergency stop protection will automatically be activated, causing the train 7 to be stopped.

[0054] In one embodiment, the frame 55 may optionally be provided with a vibration sensor 70 or an induction sensor 71. The possible passage of a train 7 over the frame 55 in question can be detected by means of said sensors. Such a provision functions as a fail-safe mode, for example in case of a malfunction in the frame concerning the transmission unit 59 and/or the receiving unit 60.

[0055] Said vibration sensor 70 or said induction sensor 71 will generate a suitable signal upon passage of the train 7, in response to which signal the communication means 61 will deliver an activation signal 61'. In a similar manner as described above, the processing unit 55 will activate the associated alerting means 64a-64b-64c to alert the track workers present in the track section in question to the approach of a train.

[0056] The induction sensor 71 is disposed in such a manner that it will generate an induction signal the moment a relatively large metal (steel) object, such as a train, passes the sensor.

[0057] As already said before, the signaling frame 55 measures the short-circuit resistance between the two rails 2a-2b caused by the short-circuit realized by the wheel axle 7a of the approaching train 7 the moment it enters the track section 1_0. To enable a correct calibration, the contact resistance between the two contacts 57a-57b of the frame arms 56a-56b and their respective rails 2a-2b is taken into account.

[0058] The signaling frame 55 is to that end calibrated for said contact resistance values on the left and the right at the two rails 2a-2b so as to prevent a possible incorrect measurement of a short-circuit resistance between the two rails caused by the short-circuit bridge realized by the wheel axle 7a of the train 7. Thus, incorrect detection or non-detection of a train in the track section is prevented, which further guarantees the safety of the track workers.

[0059] According to a safe detection method for measuring the short-circuit resistance the moment a train (in particular the wheel axle 7a) electrically connects the two rails 2a-2b, the electronics of the signaling frame 55 are designed to measure first the contact resistance between the first frame arm 56a and the first rail 2a within a few milliseconds, then the contact resistance between the other frame arm 56b and the other rail 2b, and subsequently the contact resistance between the two rails, and to compare said latter value with the sum of the individual contact resistance values between the rails and the frame arms.

[0060] In this way the electronics can quickly determine whether a correct measurement has been made. For example, it is possible to establish in this way whether the signaling frame is still correctly clamped between the rails 2a-2b or whether, due to certain circumstances, it is no longer actively (electrically) disposed between the rails. If the frame has been consciously or unconsciously removed from its position between the rails, the frame will independently detect this and in response thereto deliver a alarm signal to the central processing unit 50 via the communication means 61.

[0061] From the receipt of said alarm signal, the central processing unit 50 will conclude that the signaling frame in question is no longer functioning and that consequently the track section in question is no longer being monitored to protect the track workers. In response thereto, the central processing unit will deliver an alerting signal yet to the associated alerting means yet so as to alert the track workers to the fact that the track section in question is not being protected and that consequently they need to leave said track section.

Claims

1. A system for detecting the presence of an approaching train in a track section, comprising at least one transmission unit, which can be brought into electrical contact with a first rail, as well as at least one receiving unit, which can be brought into electrical contact with the other rail, said transmission unit being designed for emitting at least one characteristic signal via the first rail in use and said receiving unit being designed for receiving said characteristic signal via the other rail as a result of a short-circuit bridge between the two rails realized by the wheel axle of the approaching train, the system being designed to deliver at least one alerting signal upon receipt of the aforesaid signal.

2. A system according to claim 1, **characterized in that** the transmission unit and the receiving unit form part of a frame that can be disposed between the first rail and the other rail.

3. A system according to claim 2, **characterized in that** the frame comprises at least two electrically separated frame arms, which frame arms can each be individually brought into contact with a rail.

4. A system according to claim 2 or 3, **characterized in that** said frame arms are pivotally interconnected.

5. A system according to one or more of claims 2-4, **characterized in that** the frame furthermore also comprises communication means for generating an activation signal in dependence on the receipt of said characteristic signal and delivering said activation signal to a central processing unit forming part of the system.

6. A system according to claim 5, **characterized in that** said central processing unit is designed for generating at least one alerting signal in dependence on said activation signal and delivering said alerting signal to one or more alerting means.

7. A system according to claim 6, **characterized in that** said alerting means comprise at least one acoustic signal generating device.

8. A system according to claim 6 or 7, **characterized in that** said alerting means comprise at least one optical signal generating device.

9. A system according to claim 8, **characterized in that** said alerting means comprise at least one wireless receiver.

10. A system according to one or more of claims 2-9, **characterized in that** said alerting means comprise at least one wireless receiver.

11. A system according to one or more of claims 2-11, **characterized in that** said frame comprises at least one GPS module.

12. A system according to one or more of claims 2-11, **characterized in that** said frame comprises at least one induction sensor.

13. A system according to one or more of claims 1-12, **characterized in that** said transmission unit comprises a GPRS module.

14. A system according to one or more of claims 5-13, **characterized in that** the central processing unit is designed for receiving, storing and processing several activation signals from different transmission units and delivering alerting signals to the corresponding alerting means.

15. A signaling frame for use in a system according to one or more of the preceding claims for signaling the presence of an approaching train in a track section.

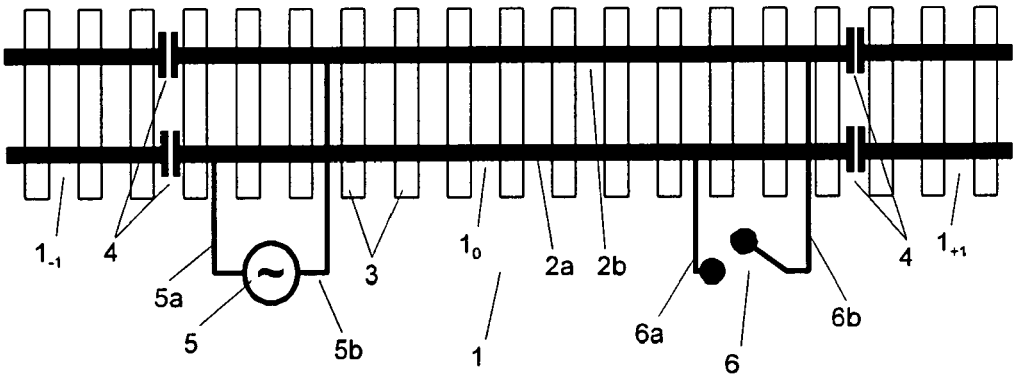


Fig. 1a

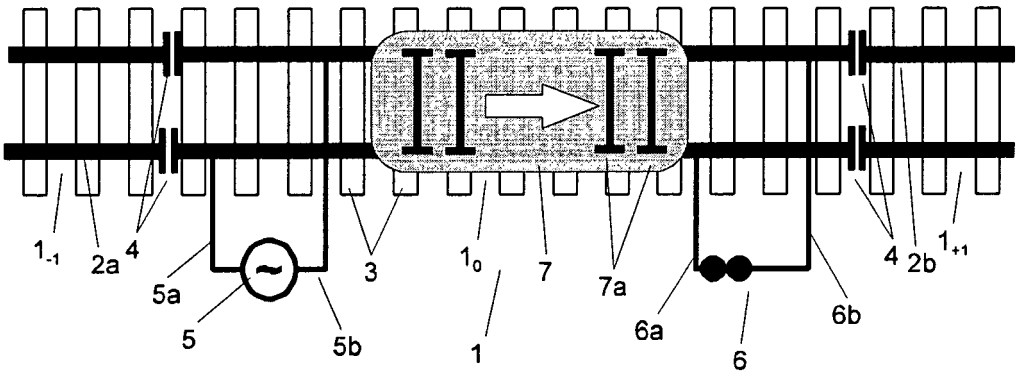


Fig. 1b

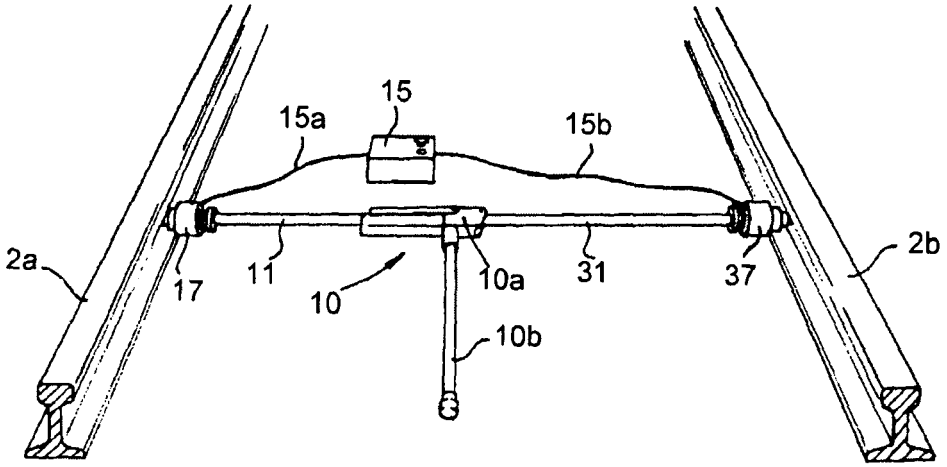
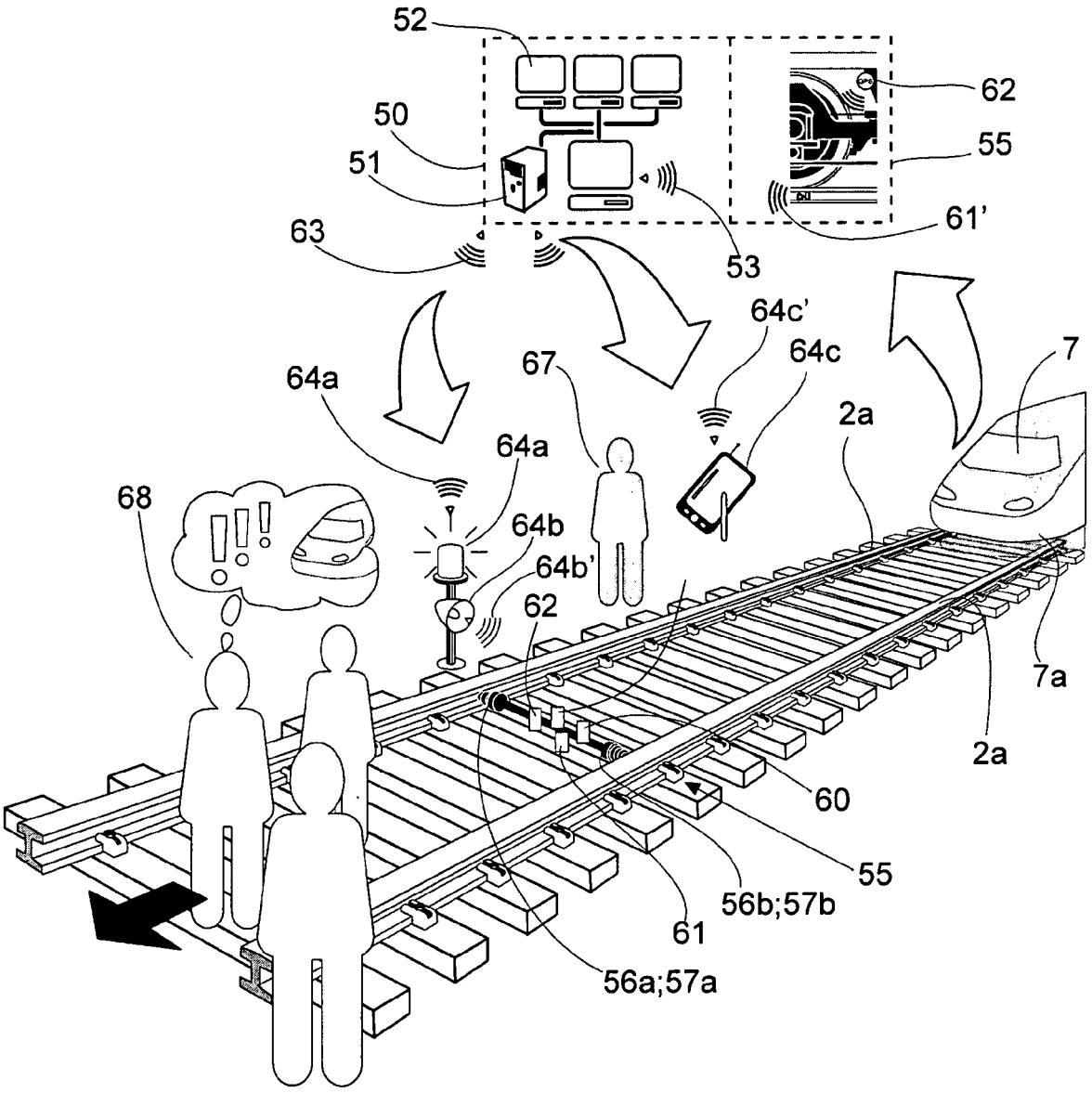


Fig. 2
(Prior Art)


52
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64c'
64c
64a
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2a
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56a;57a

Fig. 3

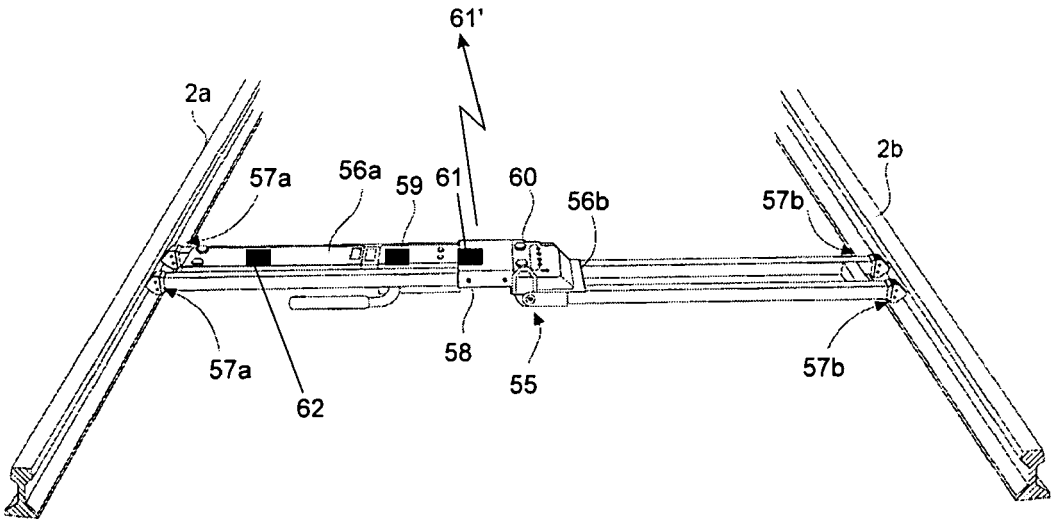

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 3449

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	NAUMANN P ED - FENNER W ET AL: "Kapitel 2.2. Geber in Fahrweg (Gleisschaltmittel)" 1 January 2003 (2003-01-01), BAHNSICHERUNGSTECHNIK, PUBLICIS, DE, PAGE(S) 45 - 61 , XP009126172 ISBN: 9783895781773	1,13,15	INV. B61L23/06
A	* page 53, paragraph 3 - page 54, paragraph 2 * * figure 2.2.7 b) *	2-12,14	

A	WO 2007/039706 A1 (MULTICLIP CO LTD [GB]; BOINTON RICHARD GUY [GB]; SHRUBSALL PETER RICKA) 12 April 2007 (2007-04-12) * page 3, line 1 - page 3, line 11 * * page 15, line 21 - page 18, line 3 * * figures 2A, 3-6 *	1-15	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 June 2010	Massalski, Matthias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 3449

DOCUMENTS CONSIDERED TO BE RELEVANT

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