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(54) **AN APPARATUS AND A METHOD FOR DETECTING DISTURBING METAL OBJECTS AT A RAILWAY TRACK SPOT**

(57) An apparatus for detecting presence at a railway track spot (1) of a metal object able to influence an integrity check of on board transmission equipment of a railway vehicle comprises a conducting loop (8) resembling a railway vehicle on board antenna with respect to shape and size and to be placed above the spot in similar relation thereto as a said antenna passing the spot. A member (9) generates an alternating current in the loop (8). Means (10) measures the impedance in the conducting loop and a unit (11) compares the impedance value measured with a predetermined impedance value for a measurement with reference structures according to established standard rules influencing the impedance and consider a detected degree of deviation of said impedance values as a presence of a said metal object at said spot able to influence an integrity check of on board transmission equipment of a railway vehicle.

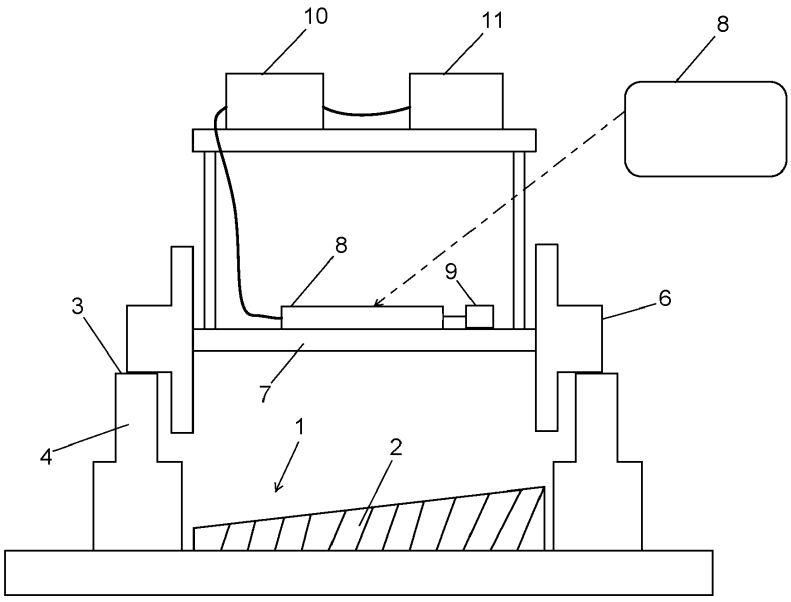

Fig 2

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Description

TECHNICAL FIELD OF THE INVENTION AND BACKGROUND ART

[0001] The present invention relates to an apparatus and a method for detecting presence at a railway track spot of a metal object able to influence an integrity check of on board transmission equipment of a railway vehicle.

[0002] Balises are distributed along railway tracks to send information from the trackside to passing trains enabling safe control of the traffic on the railway tracks through use of this information by automatic supervising systems on-board the trains (railway vehicles) moving on the railway tracks. Such an automatic supervising system is defined as an ATP (Automatic Train Protection) system, and it may for instance operate according to the European Standard ERTMS/ETCS (European Rail Traffic Management System/European Train Control System). The link between the balise and an ATP antenna on the train is based on magnetic coupling, which means that the balise and said antenna constitute an air transformer whenever the antenna is located above or in direct vicinity of the balise. This link is bi-directional, and the downlink from the transmitter on the railway vehicle transmits power to the balise by magnetic induction of the receiver loop of the balise, here called telepowering, whereas the uplink transmits data to the ATP system on-board the railway vehicle by the use of a transmitter loop of the balise through the balise transmitter powered by the electric power received by the receiver loop. This balise transmission link is described in European Standard UNISIG SUBSET-036 and Subset-100 and is based on a technology in use more than 40 years. The on-board antenna in question on the railway vehicle has to be able to constantly generate a strong magnetic field for adequate telepowering of balises in the railway track. A failure that causes the telepowering field to become too weak has therefor to be detected for taken appropriate restrictive actions. The telepowering field of the on-board antenna has therefor to be measured and supervised at all times.

[0003] Should the on-board antenna of a train encounter a metal object between the rails in the track that is positioned too high or has other shape compared to what (reference structures according to established standard rules) the on-board antenna is designed and tested for there will be a definite risk that said telepowering field becomes blocked or weakened to such an extent that the on board transmission equipment of a railway vehicle will be influenced more than by reference structures according to established standard rules causing an alarm to be generated in the on-board ERTMS system of the train. This is defined as an occurrence of an influence upon an of the integrity check of on board transmission equipment of the railway vehicle. However, the on-board system cannot know if the influence of the on board transmission equipment is due to a failure of the on board transmission equipment or due to the presence of a metal object, so it has to assume that a failure has occurred. This means that the train has to be stopped and then driven at a low speed until the system has recovered from potential missed information, such as by receiving new information at next or following balise groups.

[0004] Metal objects in the track that have to be considered and may cause such weakening of a balise telepowering field of an antenna on-board a railway vehicle may for example be metal bridges, road crossings made of metal or by reinforced concrete, reinforcement in the concrete in slab tracks and rails for track maintenance, which are temporarily placed between the ordinary rails.

[0005] Said established standard rules used in Europe according to the above European Standard specify the height, width and length of metallic objects in a railway track that the on-board system of railway vehicles shall tolerate, i.e. that shall not influence the on board transmission equipment integrity check of railway vehicles. It is up to the infrastructure owner to make sure that these requirements are met. If an object doesn't comply with these rules, i.e. if it influence the on board transmissions equipment integrity check by influencing the on board transmission equipment more than said reference structures according to standard rules, then the infrastructure owner must convey so-called Big Metal Masses information to the on-board equipment of railway vehicles, for example by putting out special balises, concerning the start position and length in distance of the railway track where the on-board integrity check alarms of a railway vehicle shall be ignored. However, it is not always easy for the infrastructure owner to determine if a metal object complies with said rules or not. This means that the infrastructure owner has to convey such so-called Big Metal Masses information, for example by putting out special balises as a safety measure along the track also when it is not clear that this type of metal objects are really present. It is evident that such Big Metal Masses information is disturbing and costly to handle, so the frequency of the occurrence thereof along a railway track should be kept as low as possible.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to provide an apparatus and a method of the type defined in the introduction addressing the problems mentioned above. This object is according to the invention with respect to the apparatus obtained by providing such an apparatus with the features listed in the characterising part of appended patent claim 1.

[0007] Accordingly, the apparatus has a conducting loop resembling a railway vehicle on-board antenna with respect to shape and size and configured to be placed above a track spot to be investigated in similar relation thereto as a said antenna on a railway vehicle when passing the spot, a member configured to generate an alternating current in the conducting loop, means configured

to measure the impedance of the conducting loop with the alternating current generated therein, and a unit configured to evaluate the result of the impedance measurement by comparing the impedance value measured with a predetermined impedance value for a measurement with reference structures according to established standard rules influencing the impedance and consider a detected degree of deviation of said impedance values as a presence of a said metal object at said spot able to influence an integrity check of on board transmission equipment of a railway vehicle. It has been found that the degree of change of the impedance of such a conducting loop corresponds to a measure of the ability of a metal object to influence an integrity check of an on board transmission equipment of a railway vehicle on a track spot where this metal object is present with respect to a track spot having a reference metal object influencing the impedance. The apparatus according to the invention makes it possible to reliably check whether a railway track spot has such a metal object requiring the provision of said Big Metal Masses information or not. This means that the infrastructure owner may refrain from such provision when a metal object complies with the standard rules and ensure that such provision is done to warn for a said spot when this has been investigated and it is really needed. This means that railway vehicles passing the sections in question will be reliably informed about when supervision failure alarms shall be ignored.

[0008] According to an embodiment of the invention said member is configured to generate an alternating current in the conducting loop with a frequency in the frequency range within which a said balise typically operates, and according to another embodiment this frequency is 20-35 MHz or 25-30 MHz. Choosing such a frequency of the alternating current results in a possibility to with a high accuracy detect presence of and evaluating the possible influence of metal objects upon an integrity check of an on-board transmission equipment of a railway vehicle. The frequency of the alternating current in the conducting loop shall be close to the typical operation frequency of a balise but may deviate slightly from the operating frequency due to any reason, and such a small difference in frequency of the alternating current results in a small deviation in test result, the actual accuracy in the full process to detect presence of and evaluating the possible influence of metal objects upon an integrity check of an on-board transmission equipment of a railway vehicle need to be considered in the final evaluation.

[0009] According to another embodiment of the invention, the apparatus further comprises an arrangement enabling detection of presence of a said metal object able to influence on board transmission equipment of railway vehicles having on board antennas with loops of different sizes more than reference structures according to established standard rules. This means that the apparatus will be able to evaluate the influence of metal objects in a track upon an integrity check of on board transmission equipment for different on-board antennas used in such equipments of railway vehicles.

[0010] Such an arrangement of the apparatus is according to another embodiment of the invention realized by the fact that apparatus comprises at least two said conducting loops of different sizes for carrying out separate impedance measurements by use of these different conducting loops. Thus, a smaller conducting loop will simulate an on-board antenna with a smaller active loop and a larger conducting loop will simulate an on-board antenna with a larger active loop for investigating how a metal object will act upon an integrity check of an on board transmission equipment having such an antenna.

[0011] According to another embodiment of the invention the arrangement is realized by the fact that the conducting loop of the apparatus is moveable to different heights above said track spot so as to carry out said impedance measurement with a conducting loop at such different heights simulating how different sizes of railway on-board antennas interact with a said reference structure and a said metal object. A metal object will block proportionally the same portion of magnetic flux or telepowering field for a small conducting test loop as for a larger loop if the small test loop is positioned on a certain higher height than the larger test loop, which means that a larger test loop and by that a larger on-board antenna loop may be simulated by lifting the conducting loop to a higher height.

[0012] According to another embodiment of the invention the apparatus comprises a carrier having members configured to rest on rails of a railway and configured to carry said conducting loop at a distance above said rails. This carrier may be moveable along a railway track for carrying out a plurality of said measurements while expanding the length of said spot and then in the form of a trolley or the bottom of a train, or it may be a part of a stand to be placed on said rails.

[0013] The object of the present invention is with respect to the method obtained by providing a method according to the appended independent method claim. The advantages of such a method and the embodiments thereof defined in the dependent method claims appear clearly from the above discussion of the apparatus according to the invention.

[0014] Further advantages as well as advantageous features of the invention will appear from the following description of embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] With reference to the appended drawings, below follows a specific description of embodiments of the invention cited as examples.

[0016] In the drawings:

Fig 1 is a very schematic view illustrating an apparatus according to an embodiment of the invention arranged on a spot of a railway track to be examined with respect to presence of metal ob-

jects, and

Fig 2 is a view of the apparatus shown in Fig 1 from the direction of the arrow II in Fig 1.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0017] An apparatus according to an embodiment of the invention will now be described while making reference to figs 1 and 2. The apparatus is designed to detect presence at a railway track spot 1 of a metal object 2 able to influence an integrity check of on board transmission equipment of a railway vehicle. The standard rules in UNISIG SUBSET-036 discussed above state for example that the highest distance of a metal object above the top 3 of a rail 4 may for a metal object extension transversal to the extension of the rail of 120 mm-200 mm be 50 mm. If the transversal extension of such a metal object is less than 120 mm it is allowed to be as high as 92 mm above the top 3 of the rails and for transversal extensions above 200 mm it may not extend above the top of the rails.

[0018] The apparatus comprises here a carrier 5 in the form of a trolley having wheels 6 configured to rest on the rails of a railway track and enabling movement of the carrier along the track for carrying out investigations of presence of metal objects between the rails at different locations, such as extending the track spot 1.

[0019] The carrier has a non-metallic base 7 onto which a conducting loop 8 resembling an on-board antenna on a railway vehicle with respect to shape and size is arranged. The shape thereof is schematically indicated to the right in Fig 2. The conducting loop is configured to be placed above the track spot 1 in similar relation thereto as a said antenna on a railway vehicle would have when passing the spot 1. This means that the carrier carries the conducting loop at a similar height above the rails as the transmitter loop of a said antenna has when the distance above the rail is at its minimum. The measuring height is choosen so that the difference of the influence of the impedance (impedance change) between the actual metal object and reference structures simulates the difference between the influence of the metal object and reference structures upon an on board antenna when this is on its minimum height. The apparatus further comprises a member 9 configured to generate an alternating current in the conducting loop with a frequency close to the frequency in which balises operate, such as approximately 27 MHz. The apparatus has also means 10 in the form of an impedance meter configured to measure the impedance of the conducting loop with the alternating current generated therein by said member 9. A unit 11 is configured to evaluate the result of the impedance measurement by comparing the impedance value measured with a predetermined impedance value for a measurement with reference structures according to established standard rules influencing the impedance and consider a detected degree of deviation of said impedance values as a presence of a said metal object at said spot able to influence an integrity check of on board transmission equipment of a railway vehicle.

[0020] Thus, the apparatus according to the present invention realises a true simulation of an interaction of an on-board antenna with a said reference structure and a said metal object to be detected making it possible to through said impedance measurements determine how much the on board transmission equipment of a railway vehicle will be influenced by a metal object possibly present on a railway track spot investigated. The use of traditional, commercially available metal detectors would not enable this but give a misleading picture of the amount of metal present in the tack, since they operate in the kHz region far away from the MHz region in which balises operate. Such metal detectors have neither any means to estimate an influence of a metal object upon on board transmission equipment compared to reference structures. An arbitrary metal object structure in a railway track with a certain height relative to the top of rails is translated to an impedance change value and based on this value to a means of judging whether or not a standard is complied with.

[0021] On-board antennas transmitter loops may have different sizes, and the present invention does for that sake provide for simulation of different such interactions of antenna transmitter loops and reference structures/metal objects and how metal objects present between rails will act upon an integrity check of an on board transmission equipment of a railway vehicle. This may be achieved by making the conducting loop 8 moveable in the vertical direction to different heights above a track spot so as to carry out impedance measurements with the conducting loop at such different heights simulating how different sizes of railway on-board antennas interact with said reference structures and said metal objects to be detected when present. Members, such as a shelf on the base 7, not shown in the figures may allow arrangement of the conducting loop at different heights. It is also possible to obtain the same simulating effect by making the conducting loop 8 arranged replaceable by at least one conducting loop of a different size for carrying out separate impedance measurements by use of these different conducting loops.

[0022] The invention is of course in no way restricted to the embodiments described above, since many possibilities for modifications thereof are likely to be obvious for one skilled in the art without having to deviate from the scope of the invention defined in the appended claims.

[0023] The impedance measuring means and the alternating current generating member may be included in one single member.

[0024] "To measure the impedance" as used in this disclosure is to be interpreted as not only cover a direct measurement of the impedance value but also an indirect measurement thereof by measuring a quantity in a determined relationship to the impedance of the conducting

loop. A measurement of a resonance frequency may show a change thereof being a measure of a change of impedance resulting from the presence of a metal object as an example of an indirect measurement of a change of impedance.

Claims

1. An apparatus for detecting presence at a railway track spot (1) of a metal object able to influence an integrity check of on board transmission equipment of a railway vehicle,
characterized in that the apparatus comprises:

   • a conducting loop (8) resembling a railway vehicle on board antenna with respect to shape and size and configured to be placed above said track spot in similar relation thereto as a said antenna on a railway vehicle when passing the spot,
   • a member (9) configured to generate an alternating current in said conducting loop (8),
   • means (10) configured to measure the impedance of said conducting loop with said alternating current generated therein, and
   • a unit (11) configured to evaluate the result of the impedance measurement by comparing the impedance value measured with a predetermined impedance value for a measurement with reference structures according to established standard rules influencing the impedance and consider a detected degree of deviation of said impedance values as a presence of a said metal object at said spot able to influence an integrity check of on board transmission equipment of a railway vehicle.

2. An apparatus according to claim 1, **characterized in that** said member (9) is configured to generate an alternating current in the conducting loop with a frequency in the frequency range within which a said balise typically operates.

3. An apparatus according to claim 2, **characterized in that** said member (9) is configured to generate a said alternating current with a frequency of 20-35 MHz or 25-30 MHz.

4. An apparatus according to any of the preceding claims, **characterized in that** it further comprises an arrangement enabling detection of presence of a said metal object able to influence on board transmission equipment of railway vehicles having on board antennas with loops of different sizes more than reference structures according to established standard rules.

5. An apparatus according to claim 4, **characterized in that** the apparatus comprises at least two said conducting loops (8) of different sizes for carrying out separate impedance measurements by use of these different conducting loops.

6. An apparatus according to claim 4, **characterized in that** the conducting loop (8) is movable to different heights above said track spot so as to carry out said impedance measurement with a conducting loop at such different heights simulating how different sizes of railway on board antennas interact with a said reference structure and a said metal object..

7. An apparatus according to any of the preceding claims, **characterized in that** it comprises a carrier (5) having members (6) configured to rest on rails (4) of a railway and configured to carry said conducting loop (8) at a distance above said rails.

8. An apparatus according to claim 7, **characterized in that** said carrier (5) is movable along a railway track for carrying out a plurality of said measurements while expanding the length of said spot (1).

9. A method for detecting presence at a railway track spot (1) of a metal object able to influence an integrity check of on board transmission equipment of a railway vehicle,
characterized by the following steps:

   a) placing a conducting loop (8) resembling a railway vehicle on board antenna with respect to shape and size above said track spot in similar relation thereto as a said antenna on a railway vehicle when passing the spot,
   b) generating an alternating current in said conducting loop (8),
   c) measuring the impedance of said conducting loop (8) with said alternating current generated therein,
   d) comparing the impedance value measured with a predetermined impedance value for a measurement with reference structures according to established standard rules influencing the impedance, and
   e) determining whether a said metal object able to influence an integrity check of on board transmission equipment of a railway vehicle is present at said spot or not by considering a detected degree of deviation of said impedance values as a presence of a said metal object.

10. A method according to claim 9, **characterized in that** in step b) an alternating current with a frequency in the frequency range within which a said balise typically operates is generated in the conducting loop (8).

11. A method according to claim 10, **characterized in that** in step b) an alternating current with a frequency of 20-35 MHz or 25-30 MHz is generated in said conducting loop (8).

12. A method according to any of claims 9-11, **characterized in that** the conducting loop (8) is in step a) placed on substantially the same or the same height as a said antenna on board a railway vehicle, preferably the minimum height of such an antenna, when passing the spot.

13. A method according to any of claims 9-12, **characterized in that** the steps a)-e) are carried out for at least two said conducting loops (8) of different sizes for detecting presence of a said metal object able to influence on board transmission equipment of railway vehicles having on board antennas with loops of different sizes more than reference structures according to established standard rules.

14. A method according to any of claims 9-11, **characterized in that** after carrying out the steps a)-e) the conducting loop (8) is moved to a different height above said track spot and the steps a)-e) are repeated with the conducting loop at that height simulating how different sizes of railway on board antennas interact with a said reference structure and a said metal object.

15. A method according to claim 14, **characterized in that** the difference in height of the conducting loop (8) for impedance measurements are 30-150 mm or 40-100 mm.

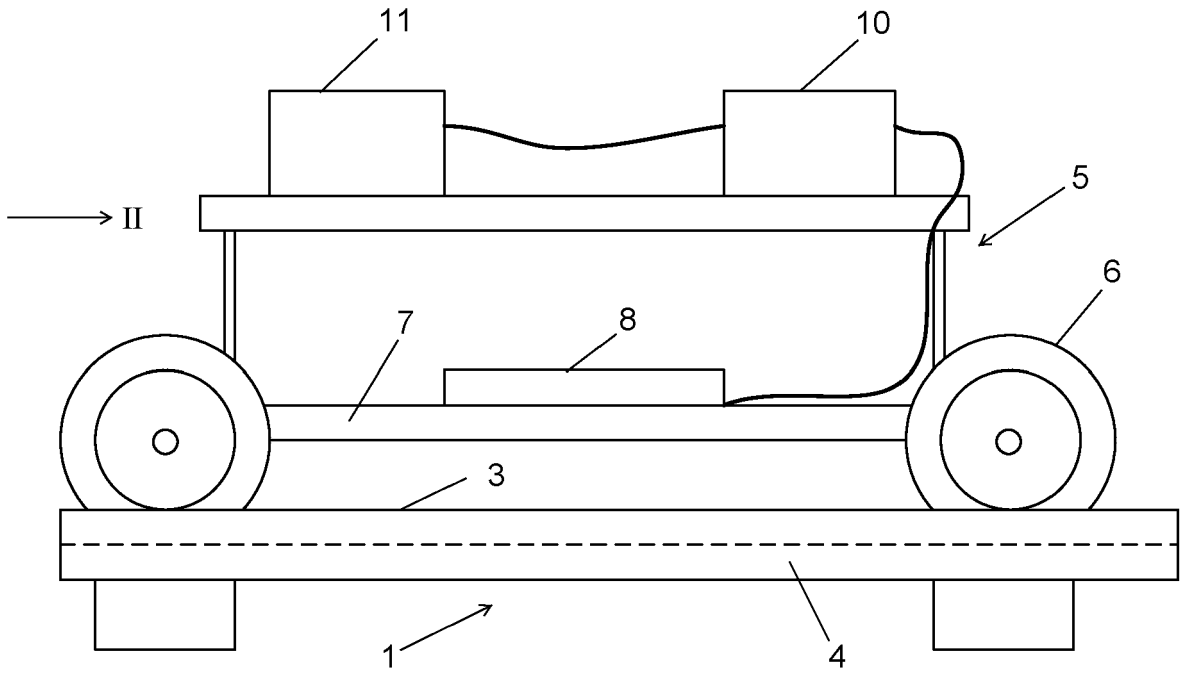

Fig 1

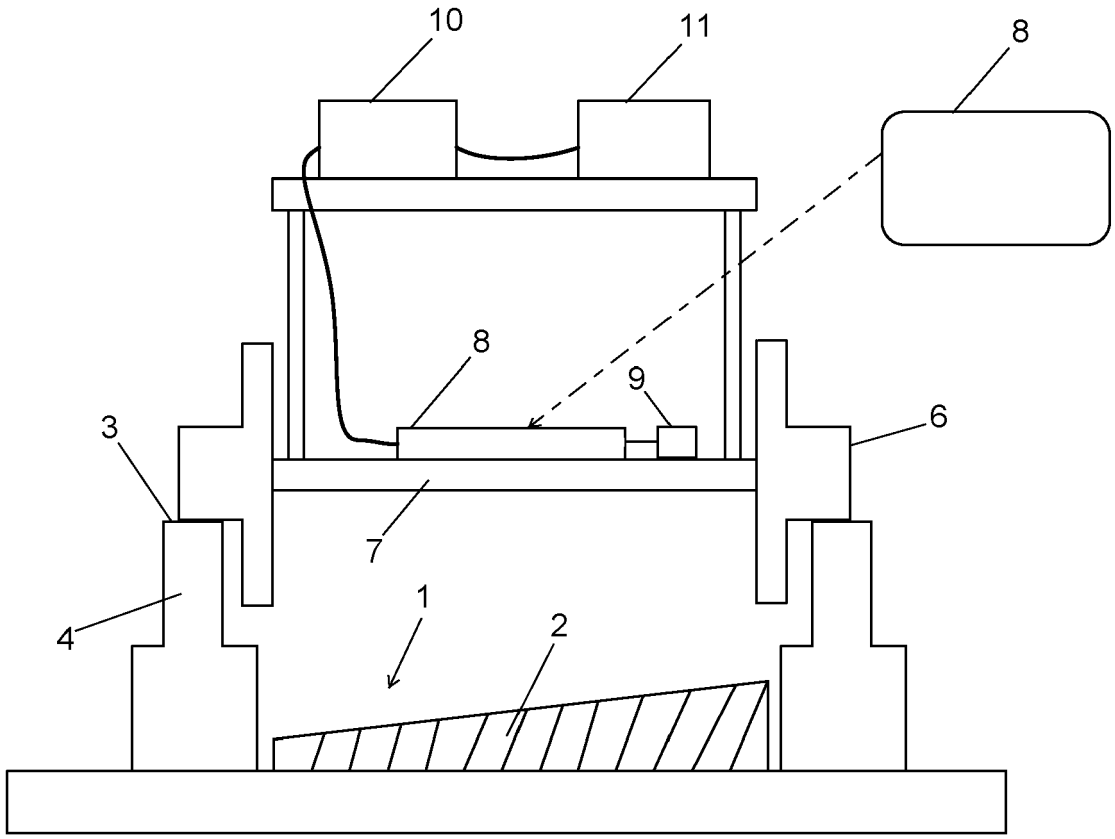

Fig 2

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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 2125

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	DE 10 2012 219161 B3 (BOMBARDIER TRANSP GMBH [DE]) 20 March 2014 (2014-03-20) * figure 1; paragraphs [0005], [0012], [0021], [0023], [0028] and [0029] *	1-15	INV. B61L3/12 B61L23/04 B61L27/00
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A	EP 2 873 585 A1 (BOMBARDIER TRANSPORTATION GMBH) 20 May 2015 (2015-05-20) * figure 1; paragraphs [0057] - [0060] *	1-15	
A	Alstom Ansaldo ET AL: "ERTMS/ETCS FFFIS for Eurobalise REF : Company Technical Approval Management approval", , 17 December 2015 (2015-12-17), XP055647946, Retrieved from the Internet: URL:https://www.era.europa.eu/sites/default/files/filesystem/ertms/ccs_tsi_annex_a_-_mandatory_specifications/set_of_specifications_3_etcs_b3_r2_gsm-r_b1/index009_-_subset-036_v310.pdf [retrieved on 2018-10-23] * paragraphs 5.7.10, 6.5.2 and 6.6.9 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)
B61L

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 December 2021	Plützer, Stefan

CATEGORY OF CITED DOCUMENTS

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13-12-2021

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82