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(54) RAIL PROFILE MONITORING, E.G. GEOMETRY OF THE FROGS

(57) Method and system for profile or geometry measurement of a railway object, e.g. rail or switch or turnout component, e.g. frog, by using optical means measuring the object, preferably by triangulation or light sectioning, wherein preferably a correction factor is applied which is dependent from the horizontal and/or vertical oscillating movement of the measuring train and which correction factor is applied to computer calculations for a geometric feature of interest of the measured track object or an associated track object, which correction factor is determined by the use of additional optical means measuring the object.

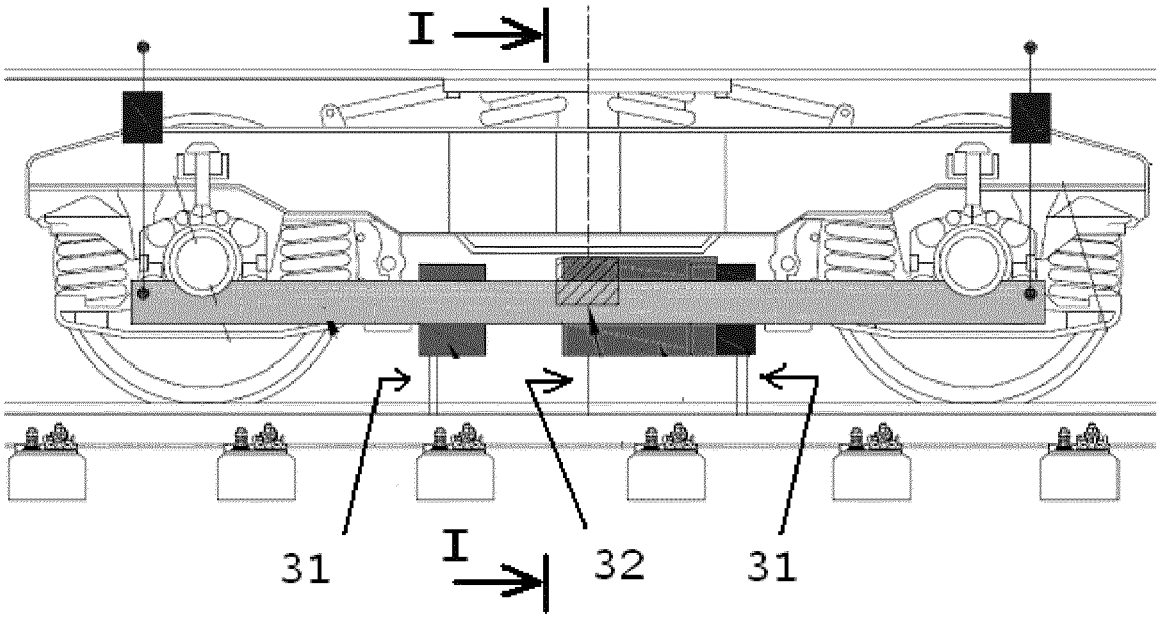

Fig. 3

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Description

BACKGROUND

[0001] This invention relates to an apparatus and method for monitoring wear and deformation of a turnout (also called switch and crossing) of a railway or tramway line.

[0002] Prior art is e.g. provided by DE19510560A1, SE515091C2, WO2008146151A2, DE102010019618A1 and EP2165915. These prior art documents also explain the principle of triangulation and light sectioning measurement.

[0003] The wear or deformation of a turnout is rather irregular and typically concentrates on particular locations, such as the stock rails, wing rails, check rails, point blades, frog and crossing.

[0004] Laser measurement systems, e.g. measuring distance or a profile of e.g. the rail head or different track component, such as triangulation sensors (one dimension measurement) or light sectioning sensors (a two dimensional extension of the laser triangulation method, thus a two dimensional measurement), offer an accuracy in the range of several micrometers at a bandwidth of 10 kHz or even higher. Their speed is therefore sufficient to measure from moving platforms (e.g. a measuring train), but it is difficult or often impossible to guide the platform with a precision comparable to the measurement accuracy. To compensate this uncertainty of the relative position of the measurement system, from practice there is known to apply an acceleration sensor to establish a virtual reference line for the value measured. A typical example known from prior art practice is the corrugation measurement of the rail head with a spectral accuracy better than 10 mu m from a running train superimposed to a vertical movement of about 10 mm.

[0005] During measurement, the vehicle speed is preferably at least 40 or 60 km/h.

[0006] A rail profile monitoring system, e.g. using a laser measurement system, is designed to measure the rail profile e.g. for high speed lines, but also for conventional and metro lines. In all cases top performances and accuracies must be guaranteed, e.g. by use of a CMOS or CCD camera system able to acquire up to 500 frames/sec or even higher rates at high resolution. The camera could e.g. be of profile or area type.

[0007] Sunlight interference and blooming effects preferably need be removed, e.g. by one or more protection systems (camera technology, pulsed laser and camera acquisition synchronized, interferential filters and software filters). The main object of the monitoring system is to give integrated indications to the track maintenance responsible for planning the interventions for the short and long term. The system preferably is able to detect and quantify all the key WEAR PARAMETERS describing the qualitative status of the infrastructure (vertical wear, transversal wear, multi-point wear, gauge).

[0008] By application of data analysis and comparison procedures, it becomes possible to optimize track maintenance plans, periodically checking and keeping under control rail degradation due to mechanical wear.

[0009] Laser light is an example of an optically coherent radiation beam. The camera is an example of a light receiving unit for monitoring the focusing projection of the radiation beam on the object of interest and converts the radiation, reflected by the object, received on a measurement surface in the receiving unit into electrical signals which are entered into the connected computer. Typically a lens, e.g. Fresnel lens, is located between the object ad the camera for focusing the radiation from the object on the measurement surface of the camera.

GEOMETRY OF THE FROGS

[0010] An object of the invention is one or more of the following: a further improvement in an attempt to sufficiently eliminate the interference of the horizontal and/or vertical oscillating movement (caused by i.a. the fact that the railway track is not perfectly straight, however in stead undulates) of the measuring train, carrying the measuring system, with the measurement results; to measure the wear or deformation of the turnout; to measure parameters of a component, such as rail, without any mechanical contact with the component and without the need to use mechanical centring devices; to acquire information relating to the actual profile of the component, its degree of wear and its vertical and transverse deformation; to be able to accurately locate the location of the measurements, particularly relative to a reference point; to effect the measurements while insensitive to oscillation and deformation of the vehicle on which the apparatus is mounted; to obtain desired results from measurements in real time; to be able to conduct the measurements at a high velocity of at least 10 or 20 km/hr of the measuring train.

[0011] This object is obtained by the invention such that the inaccuracy of a rail profile measurement is less than 0.1 millimeter.

[0012] The invention concerns a laser system and/or method designed to provide one or more of the following: emit by its one or more light sources one or more light beams, e.g. at least three or four or five light beams, designed to be projected as spaced or overlapping light points or lines or spots onto an object of interest; at least a number and preferably substantially all of these light beams are emitted such that during advancement of the measuring train these light beams are projected successively onto the same area of the object and/or their light lines successively cover the same area of the object; during train advancement the light beams and/or their light lines move along the object, one behind the other; the light beams are substantially simultaneously projected onto the object; a light line is provided by one or a plurality of separate light sources or light beams; the object of interest is of the railway track, in particular a rail, more preferably a rail part of a railway switch (also called turnout or switch and crossing) e.g. a frog or check rail

or point blade; preferably simultaneously detect these projections by a sensor or a plurality of separate sensors; the data from these sensors is entered into a computer connected to and common to these sensors; the computer determines from this data a correction factor which is dependent from the horizontal and/or vertical oscillating movement of the measuring train and which correction factor is applied to computer calculations for a geometric feature of interest of the measured track object or an associated track object.

[0013] The e.g. three or four or five light lines are preferably applied in a pattern including one or more of the following (in the following "light line" also means "light point" or "light spot"): spaced in longitudinal direction of the object, e.g. rail; close spacing between two adjacent light lines at least 5 or 10 millimeter and/or not more than 50 or 80 millimeter, e.g. approximately 30 millimeter or a single sample distance; wide spacing between two adjacent light lines at least 100 or 150 or 200 or 400 millimeter and/or not more than 800 or 900 millimeter, e.g. approximately 600 millimeter; spacing between the two outermost light lines at least 600 or 800 millimeter and/or not more than 1400 or 1500 millimeter, e.g. approximately 1200 millimeter; a light line approximately centrally between two other light lines; two light lines with close spacing, separated from the other light lines by at least the wide spacing; two sets, each of two light lines with close spacing, preferably wherein these two sets are mutually separated by at least the wide spacing; a light line separated from the other light lines by at least the wide spacing; in case of at least five spaced light lines, these are present as two sets (which light lines could be named "reference light lines") and one individual light line (which could be named "accuracy light line").

[0014] A light line could include two or more light lines (e.g. each created by an individual light emitter, e.g. laser) which are exactly or virtually exactly mutually overlapping or precisely registered such that they are detected by the associated sensor as a single line. This is e.g. the case for the accuracy light line. In an alternative for such "double" light line the individual light lines could be spaced longitudinally or differ in frequency to avoid interference, e.g. as disclosed in EP2485010.

[0015] The light lines are associated with a sensor, preferably two light lines having the close spacing are associated with a single sensor, such that the sensor (e.g. an area camera) simultaneously detects both light lines, obviously wherein these light lines are projected at the light detecting part (e.g. the light sensitive matrix) of the sensor at different locations such that they are detected separately and can be discriminated by the sensor.

[0016] The width of a light line (as measured in longitudinal direction of the rail) is preferably smaller than 20 or 10 or 5 millimeter and/or is substantially constant along its length. The light line has preferably a green or red color.

[0017] The optical axis of the imaging device, including a, preferably flat, light detection element, makes a fixed angle (preferably at least 10 and/or not more than 50 degrees, e.g. approximately 30 degrees) relative to the emitting direction of the associated laser device while the imaging device and the associated laser device have mutually fixed locations.

AS PART OF TRACK GEOMETRY MEASURING SYSTEM

[0018] Prior art is e.g. disclosed in EP2485010 and EP2165915, the disclosures of which is enclosed herein by reference.

[0019] A light line could be associated with two or more sensors (e.g. each being a profile camera), preferably this is the light line for which the wide spacing with all the other light lines applies. Preferably this accuracy light line is provided by at least two light emitters, e.g. lasers.

[0020] The accuracy light line is preferably associated with a group of two or three or four cameras such that in an embodiment the accuracy light line projected on a stock or running or different rail is simultaneously scanned by a group of at least two or three or four cameras. Thus the apparatus is provided with four cameras (two groups of two each) or even eight cameras (two groups of four each) in a preferred embodiment, to simultaneously monitor the accuracy light line projected on both opposite rails of the same track.

[0021] Preferably at least one or at least two cameras are located at both sides of the associated rail and monitor said rail obliquely from above. Preferably the location transverse to the longitudinal direction of the rail and/or the angle of inclination of the optical axis of the cameras at the same side of the associated rail mutually differs, preferably by at least 10 or 20 millimeter and 10 or 20 degrees, respectively.

[0022] Preferably the field of vision of a camera has overlapping edges with the field of vision of an adjacent camera. More preferably, the field of vision of a camera has only partly overlap, preferably not more than 20% or 50% overlap, with the field of vision of an adjacent camera at the same (one) side of the associated running or stock or different rail; (and/) or the field of vision of a camera has substantially complete overlap with the field of vision of an adjacent camera at the same (other) side of the associated running or stock or different rail.

[0023] Preferably the cameras associated with the one or other running or stock rail provide a common field of vision such that simultaneously the head of the stock or running rail and associated point blade or check rail or wing rail over its complete top and complete sides and a part of the stock or running rail and associated point blade or check rail or wing rail at least 30 or 50 millimeter below the top of the head, such as part of the foot at the bottom of the relevant rail, are scanned. For the point blade this applies preferably both in its position bearing against the stock rail and its position moved to a maximum distance from the stock rail.

[0024] The cameras are preferably connected directly to the frame grabber boards of the measurement computer. In this way images are acquired that are used to calculate the rail profile, particularly of the head and fragments of foot and web. The distance between a vision module and the relevant rail measures between 50 and 750 millimeter, particularly between 200 and 400 millimeter.

[0025] Preferably one or more of the following applies: Each emitter and receiver is dedicated to a single rail; each emitter and receiver has a fixed optical axis; each emitter and receiver is supported by or suspended from a bogy or different part of the measuring train.

[0026] Based on the measured rail profiles, one or more of the following parameters are calculated: rail head wear (vertical, horizontal, wear angle); slope of rails; track gauge; guiding rail groove width; width of the crossing nose groove; guiding width; groove width between the switch blade and the reaction rail. In the crossing of a switch there is a relationship between the frog, wing rail and checkrail, which can also be checked by the invention by measuring the gauge.

[0027] In addition, preferably one or more of the following applies: part of a system or method for measuring a rail profile by optical triangulation through optical detection systems operating by optical triangulation and moving along the rail at a movement speed, comprising respective, preferably pairs, of light emitting devices, e.g. lasers, and optical reading devices, e.g. camera's, including the steps of moving said optical detection systems along said rail at a movement speed, and lighting, preferably opposite, sides of the rail through the respective light emitting lasers, for projecting against said sides respective light spots adapted to generate respective optically detectable, preferably semi, profiles, preferably combinable, to obtain a measurement of the profile of a section of the rail, and detecting said semi-profiles through the respective optical reading devices; comprising a correcting system configured for measuring spatial variations of an optical detection system by optical triangulation with respect to the object, e.g. rail, wherein correcting the spatial position of at least one of the semi-profiles of a side through the values of the measured shifts through the correcting system; comprising cameras which operate by reading the image rows in a synchronous manner; the system comprises means configured for implementing the method; triangulation also means light sectioning.

ADDITIONAL ASPECTS

[0028] Further, preferably one or more of the following applies:

The measuring device is preferably arranged on a detecting vehicle travelling on or along the track, such as a railway vehicle, e.g. a train; the device includes essentially a light emitting device adapted to emit a light blade onto a plane which could be substantially orthogonal to the longitudinal axis of the rail; an acquisition device adapted to acquire an image containing a light row or light line generated by the intersection between the light blade and the rail; a processing module adapted to process the light line contained in the image to determine, according to the light line itself, a value correlated to the dimension of the rail; the light emitting device is arranged on the vehicle so as to be positioned over the rail and includes, e.g., a laser emitter and preferably an optical focusing assembly including a series of prisms and focusing lenses properly positioned and oriented with respect to the laser emitter to transform the focused beam into the light blade; the optical focusing assembly is capable of transforming the focused beam into the light blade having an opening angle between 20 degrees and 120 degrees so as to be able to intersect the external surface of the rail and define the light line on the external surface of the rail; the acquisition device is supported by the vehicle in a side position with respect to the emitting device so as to be arranged over the rail facing the light blade and includes a video camera or camera adapted to acquire the image of the light line projected on the rail, so as to provide in a digital format to the processing module; the processing module may include a central processing unit, e.g. a microprocessor, which is adapted to process the light line to obtain a profile measurement from part of the rail head; and a memory module for e.g. storage of data obtained from the camera or look up data, e.g. reference data; the monitoring device includes a device adapted to detect the geographic position of the detecting vehicle instant-by-instant, so as to identify, on the basis of the determined geographic position, the section of track on which the vehicle is travelling; this could include a GPS receiver (or a similar wireless operating positioning system) and/or an odometer or shaft encoder, and a memory containing, for each position, the data related to the corresponding track and to the particulars at the track; the method includes: emitting the light blade with an angular opening so as to intersect the rail head; acquiring the image containing the light line generated by the intersection of the light blade on the track; processing the image containing the light line so as to determine a feature of interest, e.g. the rail head profile and its position relative to the detecting vehicle; the method includes extrapolating the external contour of the rail head from the plurality of, preferably, at least three, four or five light lines spaced along the track and provided by a plurality, e.g. equal number of laser devices; comparing this extrapolated contour and a sample contour stored in the memory module; if there is a difference between these two contours, calculating a correction factor from this difference and correcting the extrap-

olated contour by the correction factor.

[0029] Also, preferably one or more of the following applies: the control module is configured for actuating the laser emitters to emit the laser radiation kept switched on by each laser emitter for a time of exposure which determines the lighting of a section of length of the object; a laser emitter-camera pair obtains an image of a semi-profile for a period of exposure; the one emitter switches off before another emitter switches on, e.g. they switch alternating, or they switch simultaneous; a digital camera; a camera which operates at a high speed (normally greater than 400 frames per second); a camera operates to read all the image rows in a synchronous manner; a camera speed of acquisition of 700 images per second, processing 500 rows per image, for example using an FCAM DMA camera; emitters adapted to produce beams at the same wavelength; semiconductor lasers; the period of exposure varies between 0.2 and 3 milliseconds; CMOS or CCD camera; laser power between 4 and 40W;

EXAMPLE

[0030] A non-limiting, preferred embodiment is shown in the drawing.

Figure 1 shows in sectional view along line I - I of fig. 3 the Track Geometry Measuring System in combination with the rails 1 - 4 of the turnout. This TGMS contains two groups of four cameras (vision modules) 11 - 14 and 15 - 18, respectively, each group being assigned to the left or right side of the turnout. Of each group, two vision modules 11, 12 and 17, 18, respectively, are located to the outer side, directed obliquely downwards and two vision modules 13, 14 and 15, 16, respectively, are located to the inner side of the associated rail 1 and 2, respectively, and are oppositely oriented and directed obliquely downwards. Laser sources are shown by 5 and 7, the other two laser sources directed to the opposite object side are not visible. In an alternative the TGMS contains two groups of two vision modules, each group being assigned to the objects 1,3 or 2,4, for each group the one vision module directed to the one and the other to the opposite side of the object 1,3 or 2,4. Camera and associated laser source preferably operate according to the principle of triangulation or light sectioning measurement.

Fig. 2 illustrates the main parts of a turnout: (switch) point blades 21, tie bar 22, toe 23, heel 24, stock rails 25, check rails 26, crossing 27, wing rails 28 and running rails 29.

Fig. 3 illustrates the location of the five laser lines, mutually spaced in longitudinal rail direction. Two pairs 31 have small mutual spacing. Each pair 31 has wide spacing with the other pair and with the single line 32. The single line 32 has wide spacing with all other lines. The single line is located centrally between the pairs 31. The two pairs are spaced by 1.20 meter, the lines of a pair are spaced by 30 millimetre, which is equal to the distance covered by the train moving at 60 km/h during the time elapse between two subsequent samples at a sampling rate of 500 samples/minute.

Fig. 4 illustrates an alternative to fig. 3: a pair 31 is located centrally between the other pair 31 and the single line 32.

Fig. 3 + 4 show the system suspended from a bogy of the measuring train.

Fig. 5 shows the projection of a pair of mutually closely spaced laser lines onto the rail head, created by a dedicated light blade, while a single camera 17 receives the reflection from the rail head onto its CCD matrix.

Fig. 6 shows the image provided by the camera 17, as visible on a computer display screen.

Fig. 7 shows two alternative manners how light lines can be projected onto the rail from both its sides.

[0031] Thus, the invention preferably provides a device and method for the contact less dynamic recording of the profile of a rail of a turnout to determine its condition, such as wear or deformation, comprising at least one or more of: at least one light beam from e.g. a laser device is projected onto an area of the rail facing the opposite rail and the laser device is moved along the rail and the light reflected from said area of the rail is focused onto a flat light detection element of an imaging device of which the optical axis makes a fixed angle relative to the emitting direction of the laser device while the imaging device and the laser device have mutually fixed locations such that the signal coming from the light detection element is processed in a computer processor on the basis of a triangulation procedure or light sectioning procedure to detect the distance between the imaging device and the rail, the signal from preferably at least two, three or four vision modules, which preferably form a single or virtually single projection plane directed onto the rail, is applied, means for correcting the spatial position of a measured object profile through the values of a track measuring system shift measuring means.

Claims

1. Method or and system for profile or geometry measurement of a railway object, e.g. rail or switch or turnout component, e.g. frog, by using optical means measuring the object, preferably by triangulation or light sectioning, wherein preferably a correction factor is applied which is dependent from the horizontal and/or vertical oscillating movement of the measuring train and which correction factor is applied to computer calculations for a geometric feature of interest of the measured track object or an associated track object, which correction factor is determined

by the use of additional optical means measuring the object.

2. Method or system according to claim 1, emitting by its one or more light sources at least three or four or five light beams such that during advancement of the measuring train these light beams are projected successively onto the same area of a rail of a railway track and the light beams are substantially simultaneously projected onto the rail.

3. Method or system according to claim 1 or 2, the light beams provide onto the rail light lines in a pattern spaced in longitudinal direction of the rail according to the following: close spacing between two adjacent light lines at least 5 or 10 millimeter and/or not more than 50 or 80 millimeter, e.g. approximately 30 millimeter or a single sample distance; wide spacing between two adjacent light lines at least 100 or 150 or 200 or 400 millimeter and/or not more than 800 or 900 millimeter, e.g. approximately 600 millimeter.

4. Method or system according to claim 3, spacing between the two outermost light lines at least 600 or 800 millimeter and/or not more than 1400 or 1500 millimeter, e.g. approximately 1200 millimeter.

5. Method or system according to claim 3 or 4, a light line approximately centrally between two other light lines; two light lines with close spacing, separated from the other light lines by at least the wide spacing; two sets, each of two light lines with close spacing, wherein these two sets are mutually separated by at least the wide spacing; a light line separated from the other light lines by at least the wide spacing.

6. Method or system according to any of claims 3-5, providing at least five spaced light lines, which are present as two sets (which light lines could be named "reference light lines") and one individual light line (which could be named "accuracy light line").

7. Method or system according to any of claims 3-6, a light line includes two or more light lines (e.g. each created by an individual light emitter, e.g. laser) which are exactly or virtually exactly mutually overlapping or precisely registered such that they are detected by the associated sensor as a single line.

8. Method or system according to any of claims 1-7, two light lines having the close spacing are associated with a single sensor, such that the sensor, e.g. a camera, simultaneously detects both light lines, wherein these light lines are projected at the light detecting part of the sensor at different locations such that they are detected separately and are discriminated by the sensor.

9. Method or system according to any of claims 1-8, the width of a light line, as measured in longitudinal direction of the rail, is smaller than 5 millimeter.

10. Method or system according to any of claims 1-9, the light line has a green or red color.

11. Method or system according to any of claims 1-10, the optical axis of the imaging device, including a flat, light detection element, makes a fixed angle at least 10 and not more than 50 degrees relative to the emitting direction of the associated laser device while the imaging device and the associated laser device have mutually fixed locations.

12. Method or system according to any of claims 1-11, the light line for which the wide spacing with all the other light lines applies is associated with two or more profile cameras and is provided by at least two light emitters, e.g. lasers, such that this light line projected on the rail is simultaneously scanned by a group of at least two cameras.

13. Method or system according to claim 12, wherein this light line projected onto the rail is simultaneously scanned by a group of at least four cameras.

14. Method or system according to any of claims 1-13, carried out or being part of a detecting train.

15. Method or system according to any of claims 1-14, applied to measure the geometry of the frog of a turnout.

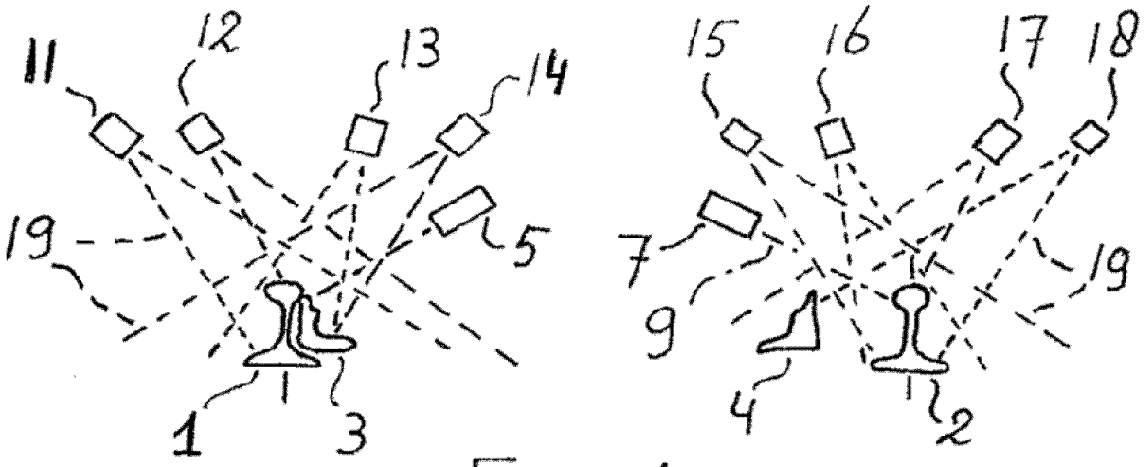

Fig. 1

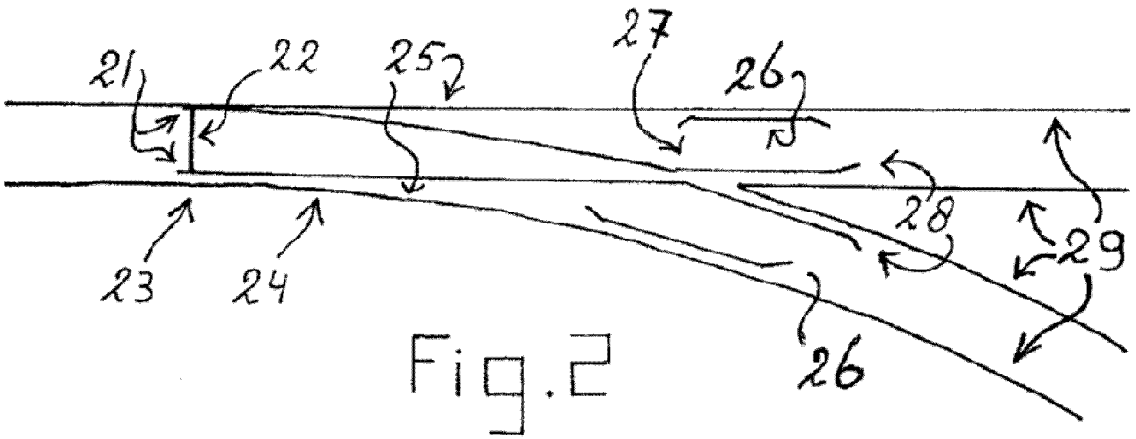

Fig. 2

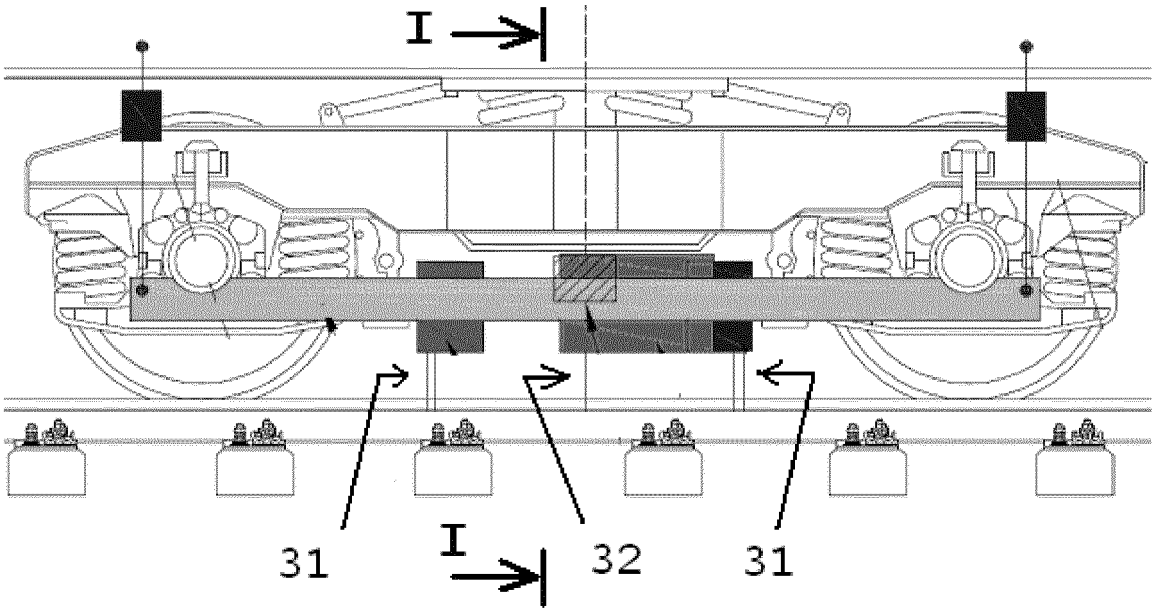

Fig. 3

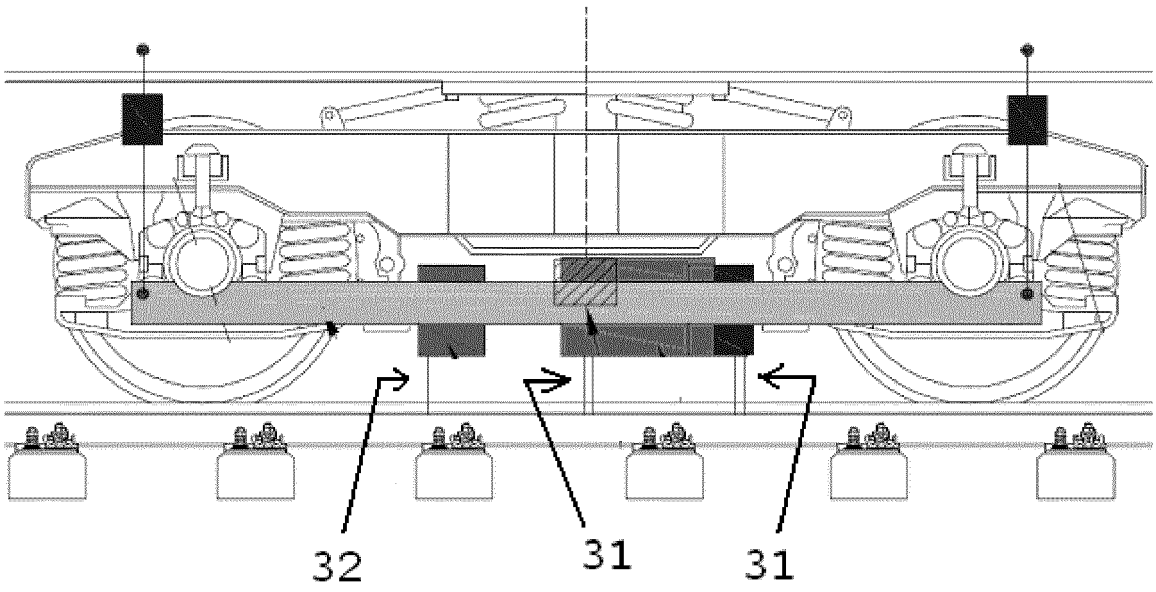

Fig. 4

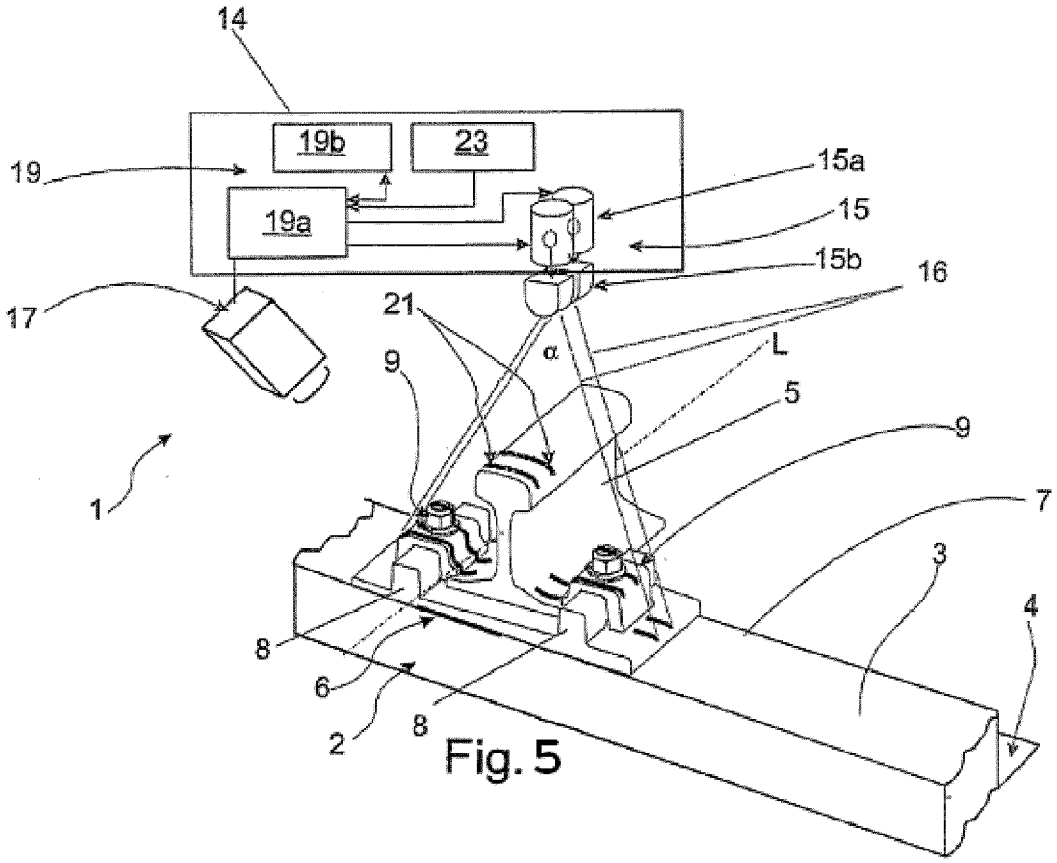
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Fig. 5

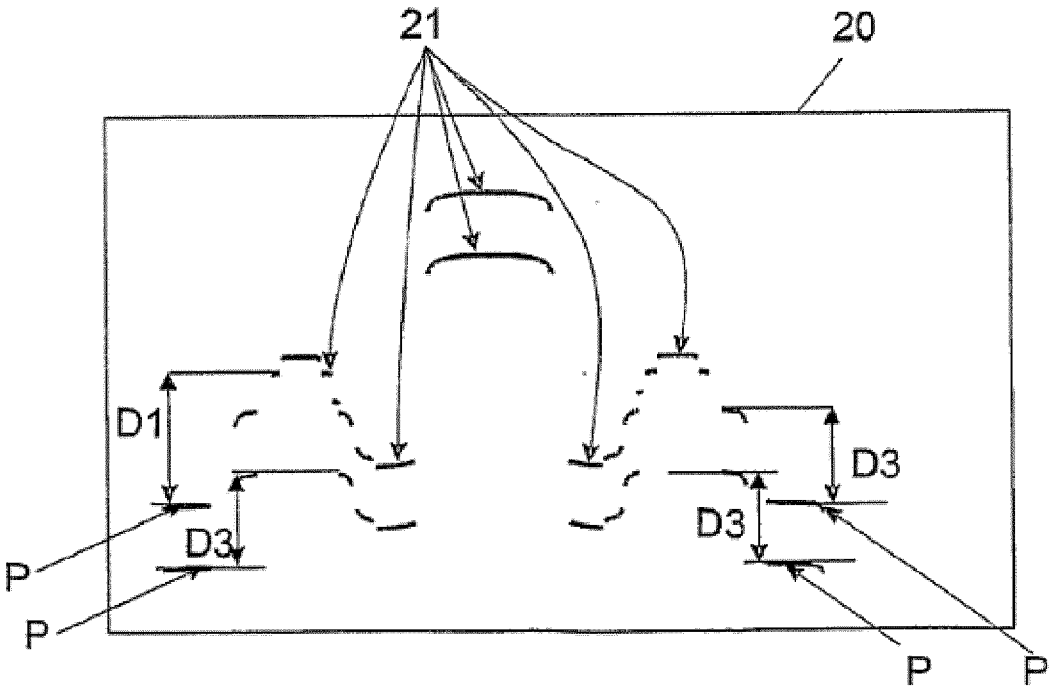
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Fig. 6

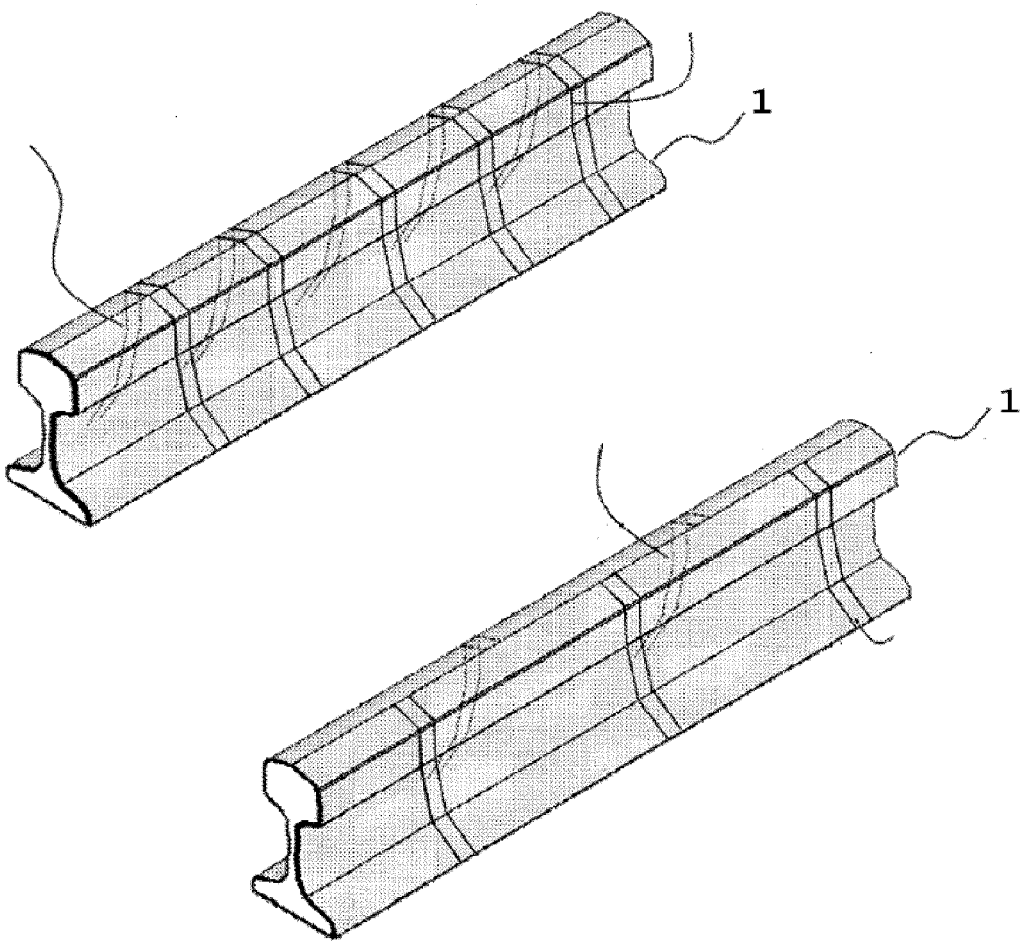

Fig. 7

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PARTIAL EUROPEAN SEARCH REPORT

under Rule 62a and/or 63 of the European Patent Convention. This report shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number
EP 16 16 6281

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	WO 01/86227 A1 (TECNOGAMMA S P A [IT]; CASAGRANDE ETTORE [IT]) 15 November 2001 (2001-11-15) * abstract; figures 4-6 * * page 1, line 14 - page 2, line 2 * * page 3, line 16 - page 4, line 5 * * page 4, line 17 - page 6, line 21 * * page 7, lines 8-18 *	1-15	INV. B61L23/00 B61L23/04
X A	WO 2012/161759 A1 (UNIV NEBRASKA [US]; FARRITOR SHANE M [US]) 29 November 2012 (2012-11-29) * paragraph [0053] - paragraph [0060] * * abstract; figure 7 *	1,2,11, 14,15 3-10,12, 13	
A	EP 1 391 690 A1 (METRIS N V [BE]) 25 February 2004 (2004-02-25) * abstract; figure 7 *	1-15	
A	US 2002/024677 A1 (METCALFE LEONARD [CA] ET AL) 28 February 2002 (2002-02-28) * paragraph [0061] - paragraph [0062] * * figure 4 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) B61L

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

Place of search	Date of completion of the search	Examiner
Munich	31 January 2017	Robinson, Victoria

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04E07)

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INCOMPLETE SEARCH
SHEET C

Application Number
EP 16 16 6281

Claim(s) completely searchable:
-

Claim(s) searched incompletely:
1-15

Reason for the limitation of the search:

The present claims do not define the matter for which protection is sought in a manner sufficiently clear for a meaningful search to be carried out across the whole of the claimed scope (Rule 63 EPC).
The extensive use of qualifying terms in the claims that make most of the features of the claim entirely optional combined with the use of "or" combinations of features leads to doubt as to which features or which combinations of features could define the claimed invention.
Omitting the entirely optional features that do not limit the scope of the claim (i.e. those introduced by "e.g." or "preferably"), the claimed invention is defined only by the following features:
Method or and system for profile or geometry measurement of a railway object, by using optical means measuring the object.
This relates to an extremely large number of possible methods and systems, such that a meaningful search across the entire claimed scope is not possible.

As indicated by the applicant the the scope of search has first been limited by omitting the word "preferably" from claim 1. However, the intended scope is furthermore unclear for the following reasons:
- The intended category of claim 1 is unclear. The designation "system" is ambiguous in that it could refer to an apparatus or a method. The claim features however seem to imply mostly method steps and no unambiguous apparatus features. This combined with the "Method or and system" designation makes it entirely unclear what is actually claimed. If both a method and an apparatus ("system") are to be protected then the method must be defined by method steps and the apparatus by apparatus features and it must be clear which features define which entity. They cannot simultaneously be protected by the same claim.
- Furthermore, the meaning of the optional features of claim 1 are also not clear in themselves for the following reasons:
- "the measuring train" lacks clarity as it has no precedent in the claims and it is (even ignoring the "preferably" qualification of the features) unclear whether a measuring train would be part of the claimed subject-matter.
- there is no precedent for "the measured track object". It is unclear whether this relates to the previously-defined "railway object" and whether the claim should be thereby be limited to measurement of track objects excluding other railway objects.
- it is entirely unclear what is meant by "an associated track object".

The dependent claims do not provide any suitable searchable definition of the invention because they also lack clarity and do not clarify the ambiguities noted above.
- In claim 2 "its one or more light sources" has no precedent and it is unclear what has the light sources and where they are.
- In claim 3, there are so many options all combined with and/or type

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phrases, that it seems that no possible spacing is ruled out (the wording "at least 5 ... millimeter ... or not more than 50 ... millimeter" already covers all possible values). Similarly claim 4 includes all real values. No limitation at all could be discerned.
- Claim 5 contains a list of features without any grammatical context to show what they are features of and whether they are to be combined with "and" or "or" type statements. They however appear to be logically mutually exclusive, but in view of the non-limiting definition of "wide" and "close" in claim 3 also non-limiting.
- Claim 6 appears to provide a designation of the light lines without actually implying any further technical features and therefore any further technical limitation.
- In claim 7 it is not known what is meant by "precisely registered" and "the associated sensor" has no precedent.
- Claims 8, 9, 10 and 12 cannot be understood to be dependent on claim 1, since the light lines are first defined in claim 3.
- In claim 11, the "imaging device" and "the associated laser device" have no precedent.
- In claim 14 it is unclear whether the "detecting train" is the same entity as "the measuring train" in claim 1.

In accordance with the indication of the applicant the following interpretation of claim 1 has been searched:
1. Method for profile or geometry measurement of a railway track object, e.g. rail or switch or turnout component, by using a measuring train carrying optical means measuring the object, wherein a correction factor is determined by the use of additional optical means measuring the railway track object and said correction factor is dependent from the horizontal and/or vertical oscillating movement of the measuring train during measuring of the railway track object and which correction factor is applied to computer calculations for a geometric feature of interest of the measured railway track object or an associated track object.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 16 6281

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