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(54) **Device composed of a theodolite, revolving on a vertical order, steady inside a container fixed to the railway engine, able to control the stability of the railway by means of targets or reflecting prisms applied on settled points parallel to the rail**

(57) The essential content of the present invetion is composed of a revolving instrument, broadcasting and receiving a laser beam,sliding Inside a container with a steady support connected to the engine's or wagon's chassis,in order to have a range of 180° if only one side of the structure has to be controlled,360° for the whole structure.In the first case the instrument will be placed on the side of the engine.In the second on the roof,central position.

On the poles, which follow the rails along each side, several targets or prisms,reflecting the laser beam emitted by the instrument, are applied.

The instrument, synchronized to the rail wheel's movement, emits the laser beam against one of the outside settled points and process its reflection,surveying the stability and so the whole railway's stability or less included within the instrument's range.

The reflecting component is composed of several parts,one of which characterized by the fact it keeps constant its vertical trim.

By comparison of all the points of the reflecting components and the respective distances from the instrument,it's possible to survey the stability or less of the settled point on which the reflecting component has been stuck, or the stability or less of the whole railway structure or both.

This invention,therefore,can be surely useful for the control of the railway structure in all its parts together and it's indispensable along the stretches used for the transit of high speed trains.

The structure,besides,can survey the railway line and the rail wheels'skid while braking,and all the other functions useful for the safety of the railway transit.

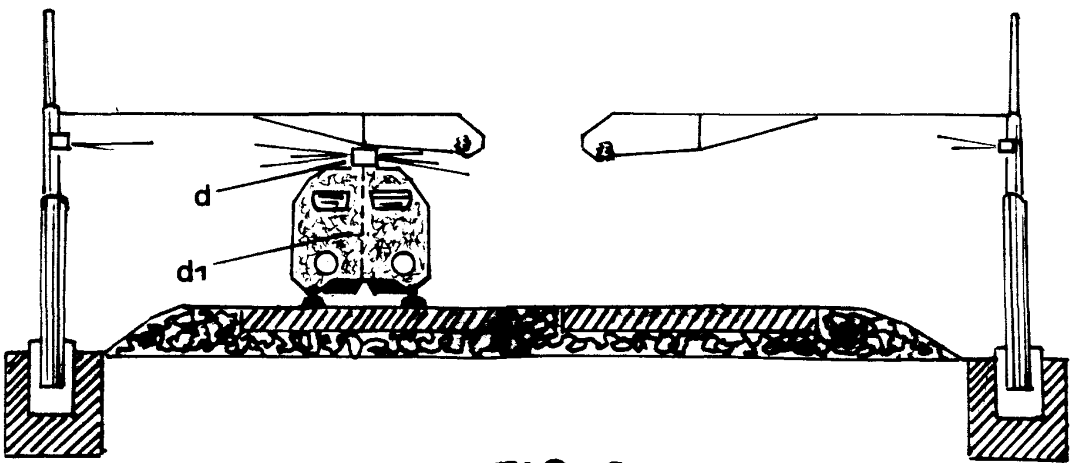

FIG. 4

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Description

[0001] The present invention refers to Physics,class G 02,and Electricity,class H04.

[0002] The current technique involves the use of a theodolite which must be manually set by a skilled operator in order to survey technical data.

[0003] The peculiarity of the present industrial invention is to have made possible the survey of the data through the emission and reflection of a laser beam from a sophisticated theodolite fixed on railway engine or a train,even moving at high speed.

[0004] The instrument is hanging and sliding inside a container in order to guarantee its own constant vertical order and an external range not lower than 180° each side. It is revolving on its own axle, with reference to the movement and the speed of the train wheels.

[0005] More than one reflecting components, one of which has a constant vertical order, are applied on poles and/or pylons and/or similars,permanent and parallel to the rails.

[0006] The instrument and the reflecting components together are able to survey the stability both of the pole (tab.1/2,fig.1(a)), and of the railway (tab.1/2,fig.1,(a4)), or of the two at the same time.

[0007] Supposing, for example, that the laser beam's time mesure is 0,5 sec. and that the train engine's speed changes from 300 km/h to 250 km/h or 215 km/h,the length of the railway necessary to make the measurement is 41.66 metres for a 300 km/h speed,34.72 metres for a 250 km/h speed and 29.86 metres for a 215 km/h speed.

[0008] Considering,at last,that the Mannesmann poles, used by the Italian Rails,are placed 60 metres far one from the other along the rectilinear stretches and 50 metres along the curvilinear ones, and taking,for example, a speed of 215 km/h, the instrument will make two measurements along the 60 metres between the two poles.

[0009] Considering,besides,that the device,to guarantee the pointing for the laser beam will have to move along his own axle in accordance with the trajectory and engine's speed, the movement of the instrument is syncronized to the train wheels' one in order to complete 90 degrees within the distance of a 1/4 of a perfect circular trajectory with a 60 metres radius,and 180 degrees within the distance of a 1 /2 circunference. As a consequence it's not necessary to stick the reflecting components on all the poles,but, alternately,only on the half part of them.

[0010] For example : along a distance of 540 metres, the reflecting component will be alternately applled only on to 4 poles (tab.2/2,fig. 7,(g,g1,g2,g3)),and not on to the 9 existing and if the engine's speed will be 215 km/h, the instrument will complete n° 2 rounds on itself, performing n°12 surveys.

[0011] Considering, besides, that all the trajectories are different from the perfectly circular ones, following, in the most part of the stretches, a rectilinear trajectory or polycentric bends through parabolic joints, and that the poles are placed not less than 1.70 metres from the rail, the line marked out by the engine won't be 180 degrees along the curvilinear trajectories,making an angle 24° less along the rectilinear trajectories.As a consequence,the instrument will be able,while working,to survey the railway line,too.

[0012] At this point, before to demostrate as the structure can guarantee the control of the railway's stability, it's necessary to analyse the reflecting component fastened to the pole and how the instrument broadcasting-receiving a laser beam is able to keep constant its own vertical order.

[0013] The reflecting component,applied to the pole, ought to have a semicircular shape and should be composed of 180 facetings,as many as the degrees of the instrument's lateral range; if we use, otherwise, some particular reflecting prisms (tab.1/2,fig.1,(a7)),only 3 of them have to be used,placed on the semicircular support at 45°,90° and 135°. The support,on which the prism has been stuck at 90°,will be indipendent and disconnected from its lateral ones.It will be protected from atmospheric and external troubles and will be able to keep its vertical order constant thanks to the special fastening and to the weigth difference between the upper and the lower part of the support.

[0014] The revolving instrument,instead,is hooked on the inside of the container by two bearings (tab.1/2,fig. 3 (c,c1)) sliding on a semicircular guide (tab.1/2,fig.1, (a6)),in order to take,moment by moment,a vertical order (tab.1/2,fig.2,(b1,b2)).The guide,provided with lateral shoulders,(tab.1/2,fig.3,(c2,c3)),on which the two bearings slide makes every movement impossible to the steady component of the instrument.In fact,the whole instrument gravitational weigth,helped by two castors close to the guide from the external side (tab.1/2,fig.3, (c4, c5)),forbid every swinging movement during its functions.

[0015] However,in practice,if it was any doubt on the effective results with this system,a batter known gyroscopic system will be used.

[0016] A possible construction of the present structure suitable to the invention has been drawn,as an example,on the enclosed tables, in which:

<u>the Figure n.1,Tab.1/2.shows:</u> a Mannesmann pole used by Italian Railways (a) on which have been stuck at a certain heigth the prisms able to reflect the laser beam (a1);a train engine from which side is projecting the container of the sophisticated theodolite, broadcasting and receiving the laser beam (a2),with a fixed support welded to the engine's chassis (a3); the foundation of the railway (a4); the theodolite with a special fastening on a semicircular guide (a6) inside the container;one of the prisms, reflecting the laser beam (a7);

<u>the Figure n.2,Tab.1/2,shows:</u> the keeping of the

vertical order of the instrument (b,b1);
the Figure n.3,Tab.1/2,shows : the two bearings (c, c1) to which the instrument inside the container is fastened;the guide provided with shoulders (c2,c3) on which the bearings slide; the two castors (c4,c5) which help,from the external side of the guide,the bearings to avoid turning movements;
the Figure n.4, Tab. 1/2, shows : the container with the instrument projecting over the train engine (d) with a range of 360° (180° each side); the container support welded to the centre of the engine's chassis (d1);
the Figure n.5, Tab. 2/2, shows : a railway semicircular trajectory (e) and another rectilinear one (e1), to demonstrate that the instrument's range,because of the distance from the poles - not less than 1.70 metres - is lower than 180° each side;
the Figure n.6,Tab 2/2, shows an example for the use of the structure : a distance covered by the engine provided with the instrument on its side equal to 120 m in a rectilinear trajectory; n°3 poles placed 1.70 m far from the rail : one at the beginning (f1), another after 60 m, on which the reflecting component has been stuck and the third after 120 metres (f3).

At the beginning, the instrument will emit the laser beam against the first reflecting prism, surveying the measure (x) with an angle of 12° to the pole. A second survey (y) will be possible when the laser beam will hit the central prism with an angle of 90° to the second pole. A third survey (z) will be taken when the beam will hit the last prism with an angle of inclination of 178°.

At this point, if we call (a) the measure x, (b) the measure y and (c) the measure z we'il have the following possibilities:

1) (a), (b), (c), equal the coordinates of origin. In this case the data surveyed by the instrument confirm both the pole's and the railway's stability;
2) only (a) has a different value from its own origin. In this case,the railway between (a) and (b) has had a varation;
3) only (c) has a different value from its own origin. In this case,the railway between (b) and (c) has had a variation;
4) only (b) has a different value from its own origin. In this case,the railway between (a) and (c) has had a variation, unless the laser beam's angle of incidence has changed.Otherwise,this means that the pole had a variation;
5) (a),(b),(c) all have different values from their coordinates of origin.In this case,or the pole has had a really great variation,or the whole stretch between (a) and (c) had it,or both the pole and the railway structure had a variation.

To know whether the variation has to be due to the pole, it's necessary another reflecting point of reference, out of the main pole,choosing it on the first or the third pole along the railway taken as an example.However,all this is unuseful,as the sophisticated computer of the instrument is able to find out the cause of the variation by itself.

In fact,considering as vertexes of a triangle the start of the railway taken for example,the central pole and the end of the line, it's possible to decide, by comparison of the surveys and the original data, and if the length of the base of the triangle is not changed, that the vatiation has to be due to the pole. On the contrary,it has to be due to the railway or to both.
the Figure n.7,Tab.2/2,shows a 540 mt railway line, along which the reflecting conponents are applied to n.4 poles (g,g1,g2,g3) and not on all the 9 existing.

[0017] In practice,of course,the structure will be able to be realized with different shapes,sizes and materials according to the different requirements,with no injuries for the validity of the present invention.

Claims

1. Structure composed of: a theodolite, broadcasting and receiving a laser beam,hanging and sliding inside a container with a support fastened to the train engine's chassis or wagons, characterized by fact that the theodolite keeps a vertical trim and an external range measuring 180 degrees laterally and/ or 360 degrees each side of the rail.

2. Structure as the claim 1), characterized by fact that the theodolite emitting-receiving the laser beam and provided with a sophisticated computer has been synchronized to the rail wheels' movement according to their speed.

3. Structure as the claims 1) and 2), characterized by fact that more reficting components, targets or prisms, one of which in constant vertical trim, are stuck to the poles and/or pylons and/or similar supports,steady and parallel to the rails.

4. Structure as the claims 1),2) and 3), characterized by fact that it is able to control the whole railway's stability.

5. Structure as the claims from 1) to 4),characterized by fact that it's possible to survey the track and the stability of the rails thanks to the angular varian-tions,equal to 180° for the semicircular bends, less for the parabolic and polycentric ones.

6. Structure as the claims from 1) to 5),characterized by fact that by the comparison of the triangle measures,whose vertexes are the starting point,the reflecting pole and the end of the stretch taken as an example it's possible to have the information about the probable spatial variations of the pole,the railway structure or both.

7. Structure as the claims from 1) to 6), characterized by fact that the theodolite,placed in a central position on the engine,will extend its range to 360 degrees, involving both sides of the whole railway structure.

8. Structure as for the claims from 1) to 7),characterized by fact that it will be possible, through the data surveyed by the instrument,to control not only the railway but even the engine's functioning.

9. Structure as the claims from 1) to 8), characterized by fact that the data surveyed by the instrument are processed by the same or by a computer placed in the engine's control cab,or more,broadcast, through telematic systems,to an external processing station.

10. Structure as the claims from 1) to 9), characterized by fact that it can be modified during the costruction according to different requirements without injuries to the validity of the present invention.

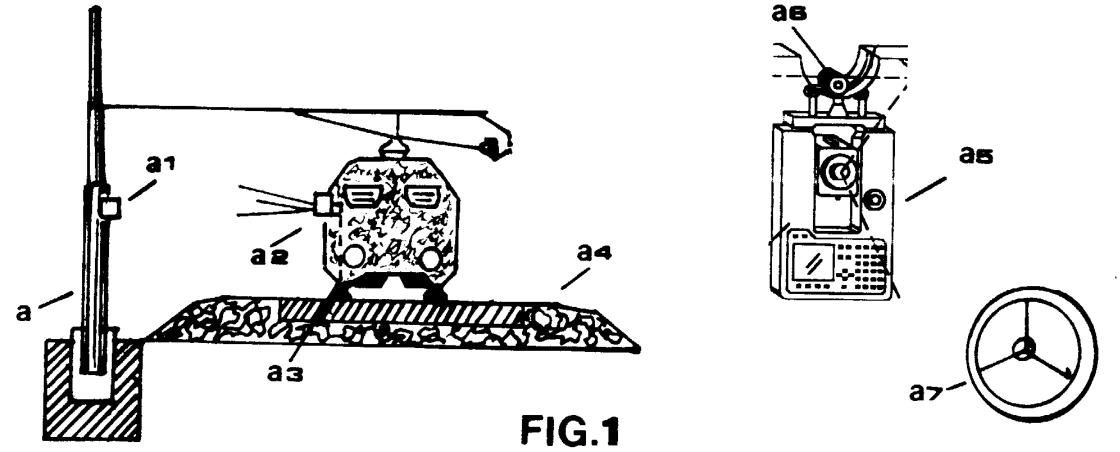

FIG.1

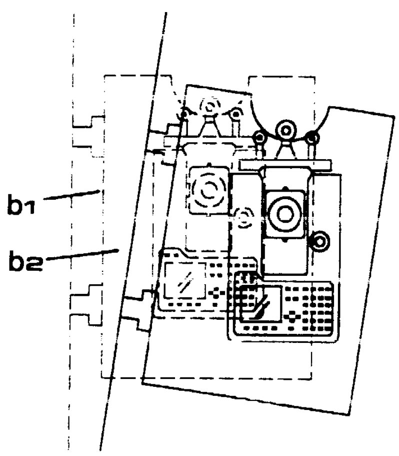

FIG.2

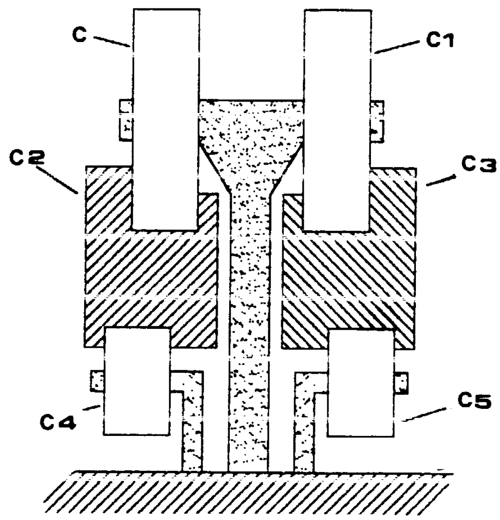

FIG.3

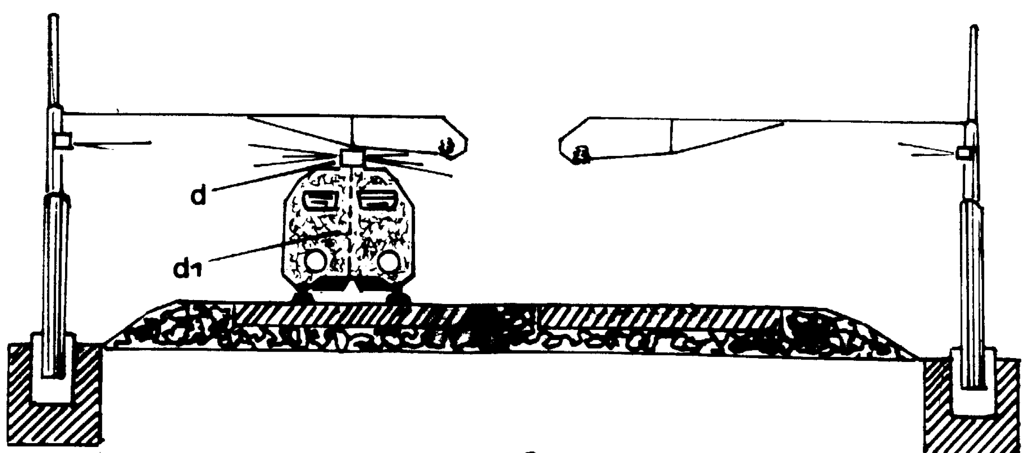

FIG. 4

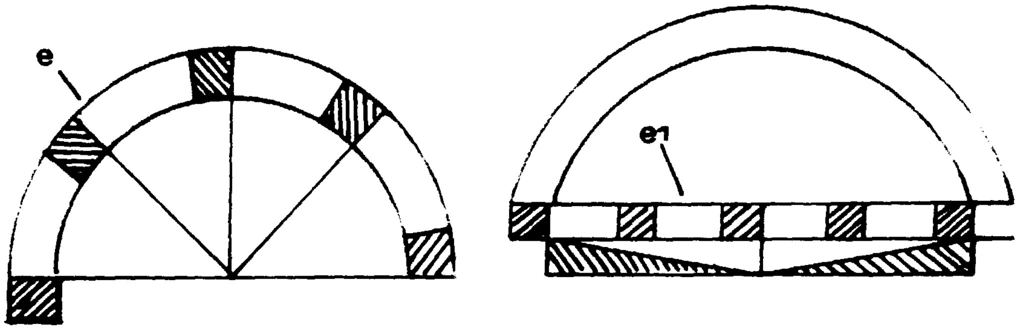

FIG. 5

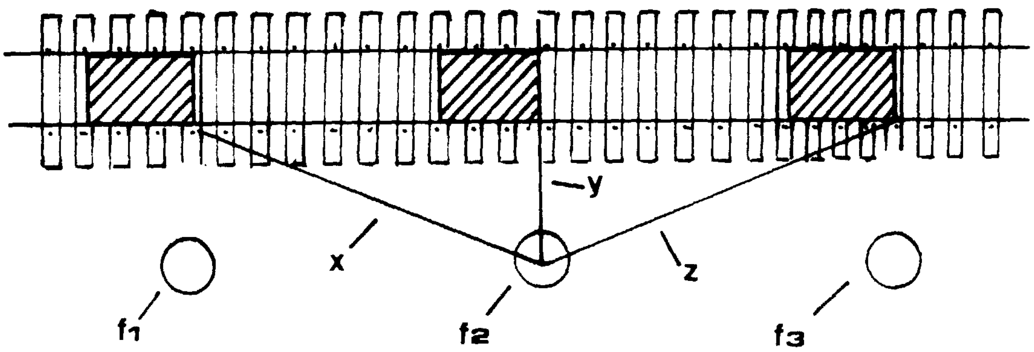

FIG. 6

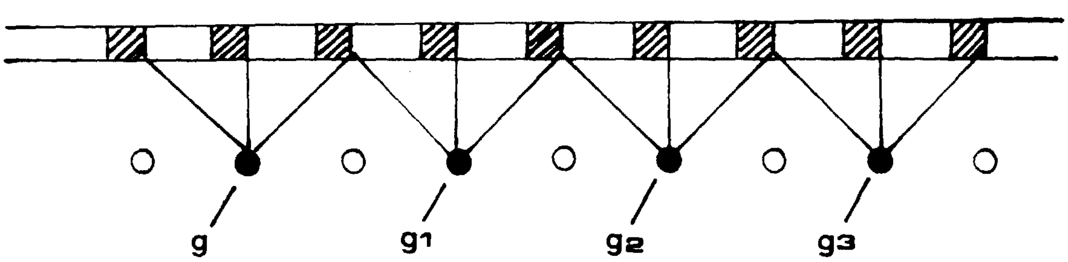

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0389

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B61K
B61L
G01S

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 November 1999	Chlosta, P

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