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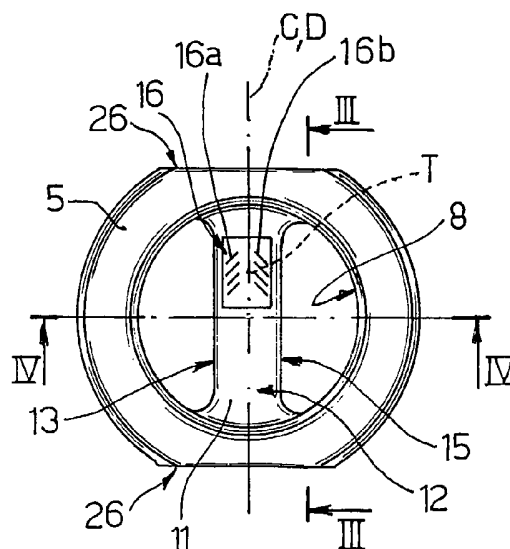
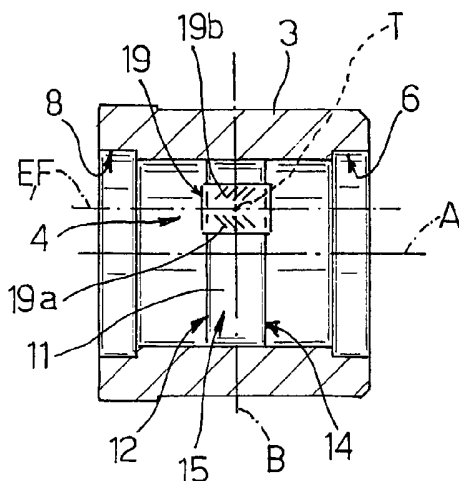
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(54) Title: MEASURING DEVICE FOR LOADS ACTING ON RAILS



(57) Abstract: A measuring device (1) for loads acting on a rail (21), the device (1) comprising a support (3) defining a hole (4) having a first axis (A) adapted to being perpendicular and coplanar to an axis of symmetry (S) of said rail (21), at least one first and one second flat inside the hole (4), and at least one first and one second measuring instruments (16, 17) respectively supported on said at least one first and one second walls (12, 13), in which the first wall (12) is perpendicular to and crossing the first axis (A) and the second wall (13) is parallel to the first axis (A) and further that the first and second measuring instruments (16, 17) are adapted to measure respectively a first and a second shear loads (Y, Q) acting respectively on directions parallel to the first axis (A) and to the axis of symmetry (S).

MEASURING DEVICE FOR LOADS ACTING ON RAILS

TECHNICAL FIELD

The present invention relates to a measuring device
5 for loads acting on a rail.

BACKGROUND ART

A train which stands or runs on a railway or tramway
line rests its wheels in contact with the rails thus
exerting static or dynamic load forces, such as for
10 example the weight force or the lateral force due to
centrifuge acceleration on corners.

The resultant of the load forces can be resolved
according to a reference system integral with the rail
and comprising a longitudinal direction parallel to the
15 axis of the rail, a transversal direction parallel to the
axis of symmetry of the cross-section of the rail and a
lateral direction orthogonal to the other two directions.

For example, when the rail rests on a horizontal
plane, the transversal component is parallel to the
20 weight force, while the lateral component is generated by
the action of the wheel edge on the rail by effect of
centrifugal acceleration on bends.

It was found that the ratio between the lateral
component and the transversal component is a useful
25 indicator to evaluate the cornering stability of the
train. Furthermore, the value of the transversal

component is the parameter which allows to evaluate the railworthiness of a train and contributes to estimating the deterioration of the railway line.

There are known measuring systems of loads acting on a rail which include a device aboard the train adapted to detect the lateral component and at least one device integral with the rail adapted to detect the perpendicular component.

The known systems present a complicated set-up step and have high costs.

DISCLOSURE OF INVENTION

It is the object of the present invention to achieve a device for measuring the loads acting on rails which is free from the aforementioned drawbacks, easy to make and has low manufacturing costs.

The present object is achieved by a measuring device according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, it will now be described a preferred embodiment only by way of non-limitative example, and with reference to the accompanying drawings, in which:

- figure 1 is an exploded axonometric view of a measuring device according to the present invention;
- figure 2 is a frontal view of the device in figure 1;

- figure 3 is a section view taken along line III-III in figure 2;

- figure 4 is a section view taken along line IV-IV in figure 2;

5 - figure 5 is a diagram related to the electrical connection of the device in figure 1; and

- figure 6 is an axonometric view not in scale and with parts removed for clarity of the device in figure 1.

BEST MODE FOR CARRYING OUT THE INVENTION

10 In figure 1 it is indicated with 1, as a whole, a measuring device integrally including a bushing 3 defining a circular through hole 4 having a straight axis A, and a shaped end flange 5.

The hole 4 defines an end opening 6 closed by a
15 circular lid 7 and the flange 5 defines an opening 8 closed by a circular lid 9 and presenting a pair of holes 10 diametrically parallel to axis A (figure 1).

Inside the hole 4 the device 1 includes a prismatic sensitive element 11 having a straight axis B diametrical
20 with respect to axis A (figures 2, 3 e 4).

In particular, the sensitive element 11 presents a square cross-section defined by a first pair of walls 12, 14 perpendicular to the axis A and a second pair of walls 13, 15 perpendicular to the walls 12, 14 (figures 2 and
25 3).

The device 1 also includes four measuring

instruments 16, 17, 18, 19 respectively supported by the walls 12, 13, 14, 15 and including respective pairs of monoaxial strain gauges, 16a, 16b, 17a, 17b, 18a, 18b, 19a, 19b, reciprocally forming a 90° angle.

5 In particular, the strain gauges 16a, 16b and 18a, 18b are arranged symmetrically to respective axes of symmetry C, D of the walls 12, 14 and coplanarly to axis B, and the strain gauges 17a, 17b and 19a, 19b are arranged symmetrically to respective axes E, F laying
10 both on the respective walls 13, 15 and on a plane perpendicular to axis B.

The strain gauges of the devices 16a, 16b, 18a, 18b, are reciprocally connected by a full-bridge electrical circuit 20 schematically shown in figure 5 and presenting
15 wires for feeding and taking the signal output from the holes 10 of the lid 9. The strain gauges 17a, 17b, 19a, 19b are reciprocally connected similarly as the strain gauges 16a, 16b, 18a, 18b.

In use, the device 1 is fitted aboard a rail 21
20 having a straight or curved longitudinal axis L and presenting a flat support support wall 22 in contact with the sleepers (not shown) of a railway line, a rib 23 perpendicular to the support wall 22 and a beam element 24 adapted to cooperate with the wheels of a train and
25 arranged on the opposite part of the support wall 22 with respect to the rib 23.

The rail 21 presents a cross-section having an axis of symmetry S and a shear centre T laying on the axis of symmetry S in a position known and established by a specific standard, for example Italian standard UNI 3141.

5 The standard also establishes the dimension and position with respect to the shear centre T of holes 25 realised perpendicularly to the axis S along the rib 23 and adapted for generic purposes, for example for bolting a connecting flange plate to another rail.

10 In particular, the bushing 3 is dimensioned to be interference fitted in one of the holes 25 allowing an optimal transfer of the stresses from the rail 21.

 Furthermore, the sensitivity of the device 1 depends on the position of the sensitive element 11 with respect
15 to the shear centre T of the axis of symmetry S and therefore the flange 5 presents a pair of flats 26 parallel both to each other and to axis A and perpendicular to axis B of the sensitive element 11. Furthermore, the measuring instruments 16, 17, 18, 19 are
20 glued to the respective walls 12, 13, 14, 15 reciprocally side by side and so that the axes of symmetry E, F of the strain gauges 17, 19 and the shear centre T are coplanar. For example, the axes E, F are arranged at 4.5 millimetres from the axis A to be coplanar with the shear
25 centre T according to the specifications of Italian standard UNI 3141.

The operation of the device 1 is as follows.

The wheel of a train exerts on the rail 21 a perpendicular force Q parallel to the axis of symmetry S and a lateral force Y perpendicular to the force Q , both
5 forces acting on the beam element 24 on a plane perpendicular to the axis L .

On a plane crossing the axes L and S , the force Q generates on the rail 21 a shear which follows with high approximation the shear diagram of a freely supported
10 beam loaded by a concentrated force.

On a plane perpendicular to the axis L , the force Y generates on the rail 21 a shear that follows with high approximation the shear diagram of a beam restrained at one end and loaded by a concentrated force perpendicular
15 to the axis of the beam and applied onto the opposite end with respect to the restrained one.

The shear of the force Q is measured on the walls 12, 14 being the axes C , D parallel to the force Q itself and the shear of the force Y is measured on the walls 13,
20 15 being the axes E , F parallel to the force Y itself so that the respective monoaxial strain gauges lay parallelly to the main stresses on each wall 12, 13, 14, 15.

With this regard, it is important to point out that
25 according to the elastic linear theory laws, the shear of the force Q on the walls 12, 14 is independent from the

shear of the force Y on the walls 13, 15 and the strain gauges, surrounding the shear centre which belongs to the axis S, are found in the highest shear stress point without undergoing the mutual contributions of the bending stresses caused by the forces Q, Y.

In particular, the bending stress due to the force Y on the faces 12, 14 or due to the fact that the force Q is applied along a line parallel to the axis S, must be minimum insofar as the axis B of the sensitive element 11 lays along the axis S which is the neutral axis for a bending on a plane orthogonal to the axis L.

Furthermore, each group of four strain gauges is arranged symmetrically with respect to the shear centre and detects elongations percentually equal to in modulus and different in sign, allowing the full-bridge connection.

From an examination of the features of the measuring device carried out according to the present invention are apparent the advantages that it allows to obtain.

In particular, it is possible to measure at the same time the forces Q and Y with a single device mountable aboard the rails.

The device 1 is also simple and cheap to carry out and is compatible with the railway standards.

In order to increase the measurement sensitivity, the strain gauges symmetrically surround the shear centre

T of the rail section 21.

Furthermore, during assembly, the device 1 is precisely and simply positionable with respect to the axis S by means of the flats 26.

5 It is finally apparent that modifications and variations can be made to the device herein described and illustrated without departing from the scope of protection of the present invention, as defined in the accompanying claims.

10 In particular, the sensitive element may be carried out separately with respect to the bushing 3 and then fitted and connected rigidly, for example by interference fitting with the supporting bushing and with particular attention to the continuity between sensitive element and
15 rail.

CLAIMS

1. A measuring device (1) for loads acting on a rail (21), said device (1) comprising a support (3) defining a hole (4) having a first axis (A) adapted to being perpendicular and coplanar to an axis of symmetry (S) of said rail (21), at least one first and one second flat wall (12, 13) rigidly connected to said support (3) inside said hole (4), and at least one first and one second measuring instruments (16, 17) respectively supported on said at least one first and one second walls (12, 13), characterised in that said first wall (12) is perpendicular to and crossing said first axis (A) and said second wall (13) is parallel to said first axis (A) and in that said first and second measuring instruments (16, 17) are adapted to measure respectively a first and a second shear loads (Y, Q) acting respectively on said directions parallel to said first axis (A) and to said axis of symmetry (S).

2. A device according to claim 1, characterised in that it includes a prismatic sensitive element (11) having a second axis (B) radial with respect to said first axis (A) and integrally comprising said at least one first and one second walls (12, 13).

3. A device according to claim 2, characterised in that said sensitive element (11) includes a third and a fourth wall (14, 15) respectively parallel to said at

least one first and one second walls (12, 13) and respectively supported by a third measuring instrument (18) similar to said first measuring instrument (16) and a fourth measuring instrument (19) similar to said second
5 measuring instrument (17).

4. A device according to claim 3, characterised in that each of said measuring instruments (16, 17, 18, 19) includes two strain gauges (16a, 16b, 17a, 17b, 18a, 18b, 19a, 19b) reciprocally forming a 90° angle and arranged
10 symmetrically with respect to respective third, fourth, fifth and sixth axes (C, E, D, F) being said third and fifth axes (C, D) coplanar to said second axis (B) and said fourth and sixth axes (E, F) coplanar to a plane perpendicular to said second axis (B).

15 5. A device according to claim 4, characterised in that said strain gauges (16a, 16b, 17a, 17b; 18a, 18b, 19a, 19b) are respectively connected in a full-bridge manner.

6. A device according to any of the preceding
20 claims, characterised in that said support (3) is a bushing adapted to being rigidly connected to said rail (21).

7. A device according to claim 7, characterised in that said support (3) comprises a flange (5) coaxial to
25 said first axis (A) and presenting a pair of reference flats (26) reciprocally parallel and perpendicular to

said at least one first and one second walls (12, 13).

8. A device according to any of the preceding claims, characterised in that said rail (21) presents a transversal section having a shear centre (T) and in that
5 said at least one first and one second measuring instruments (16, 17) surround said shear centre (T).

9. A device according to any of the preceding claims, characterised in that said at least one first and one second walls (12, 13) are mountable on said support
10 (3).

10. A rail (21) characterised in that it includes a measuring device (1) according to any of the preceding claims.

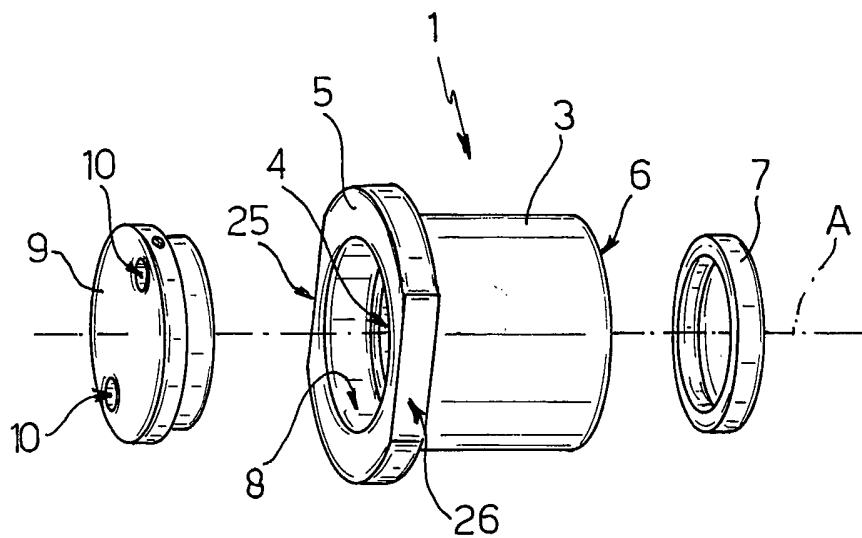


Fig.1

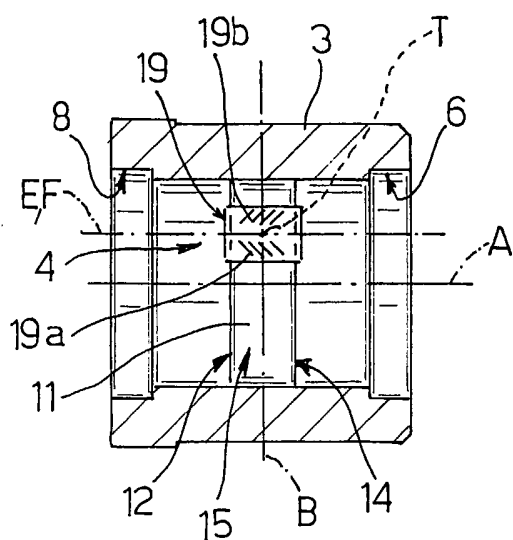


Fig.3

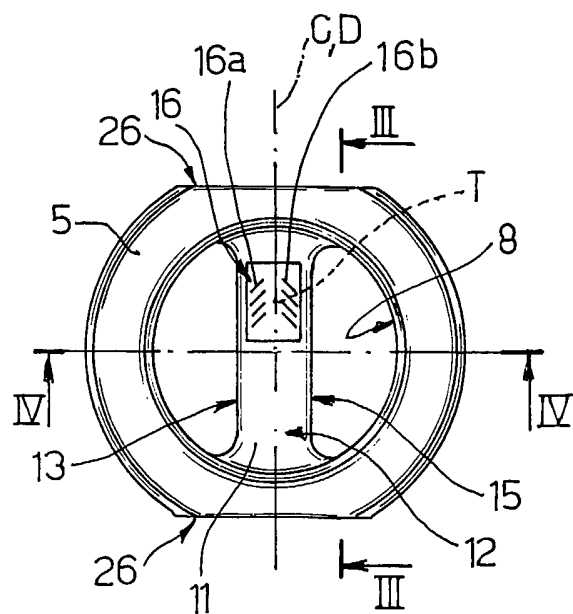
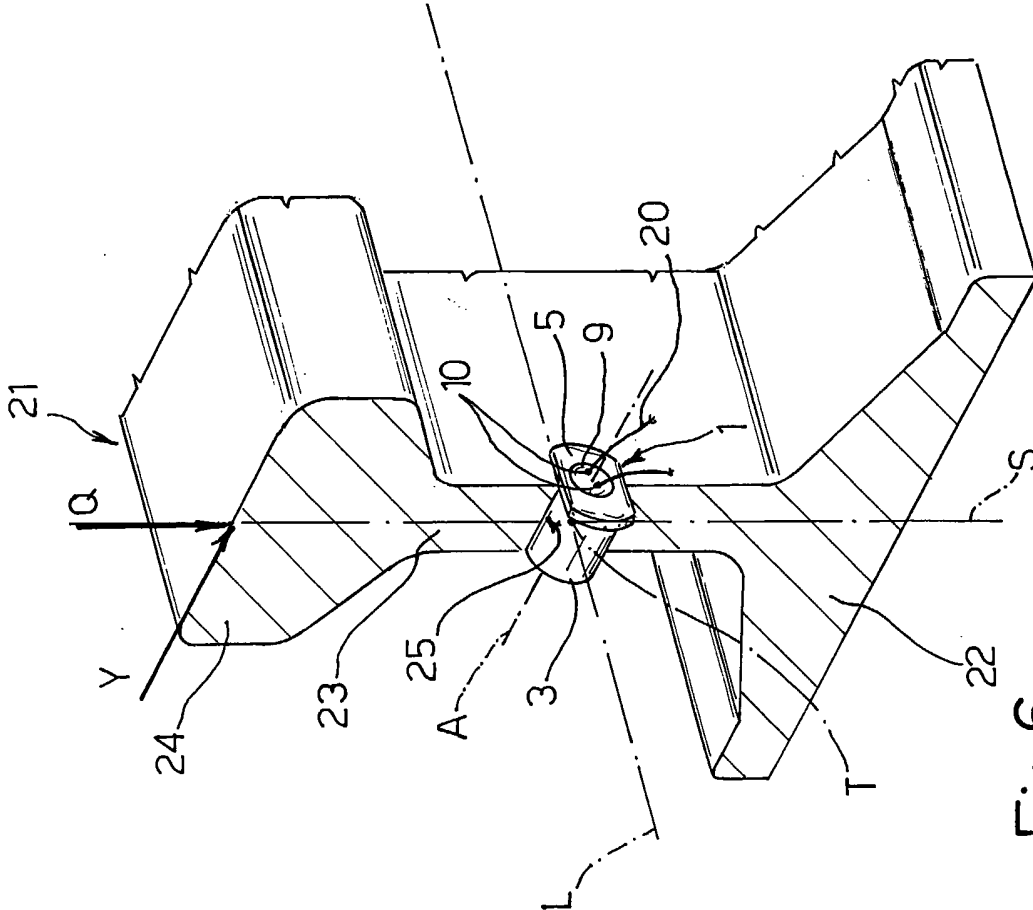
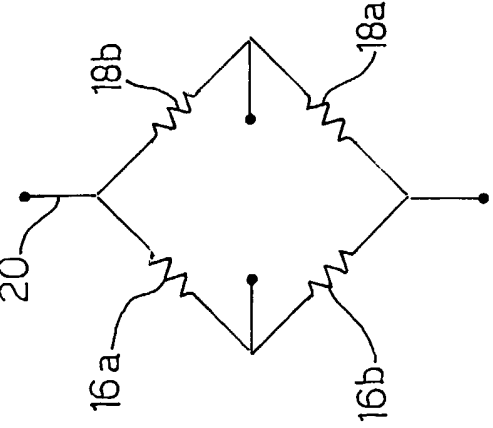
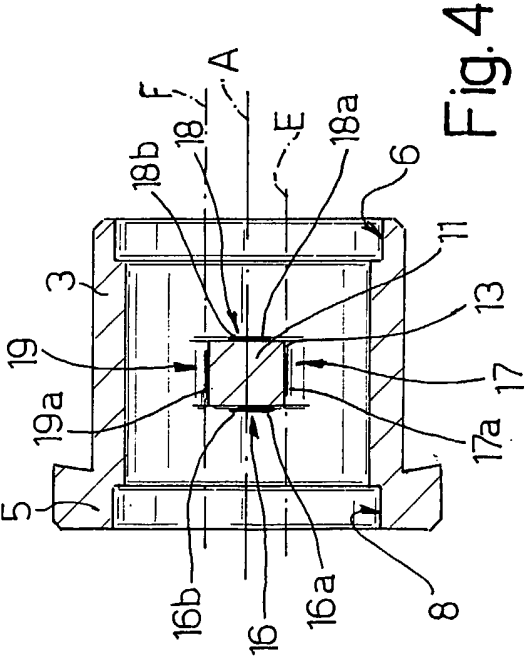


Fig.2



INTERNATIONAL SEARCH REPORT

International Application No
PC1/1B2005/002850

A. CLASSIFICATION OF SUBJECT MATTER
G01L5/00 G01G19/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G01G G01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

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egno/pdfs/AL027.pdf">http://pcm.dmti.unifi.it/aias/xxx_conv egno/pdfs/AL027.pdf > paragraphs '0002! - '0004!; figures 1,2 ----- -/--	1,8,10

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☒ Patent family members are listed in annex.

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International Application No.

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