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(54) MEASURING WHEEL FOR MEASUREMENT OF RAIL-WHEEL FORCES

(71) We, FRIED. KRUPP HÜTTENWERKE AKTIENGESELLSCHAFT a German Company of D-4630 Bochum, Federal Republic of Germany, do hereby declare

the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:

The invention relates to a measuring wheel for measurement of rail-wheel forces, and to a rail vehicle having such a wheel.

Measuring wheel sets, in which wire strain gauges are arranged on the wheel rim or the wheel spokes, or on the axle shaft, have been developed for examining the forces which arise between the wheel and the rail. The slowly varying (approx. 10 Hz - 20 Hz) vertical and horizontal (or, more accurately, perpendicular and parallel) forces which are critical for derailment safety are detected in the contact area of such a wheel set with the rail surface. However, it is possible with these wheel sets to detect forces in the wheel contact area which vary more quickly (approx. 20 Hz - 10 KHz). In the case of these medium- and high-frequency forces, the vertical forces in particular play an important part with respect to the entire superstructure as well as the wheel set. This particularly applies for the material stress in the proximity of the wheel contact area, i.e. in the rail running surface and the wheel running surface. This stress can lead to cracking in the rail running surface and in the wheel running surface, to flats on the wheel running surface and to rippling in the rail running surface.

Known processes for detecting the forces arising between the wheel and the rail do not permit the instantaneous contact point with the rail to be exactly localised in the wheel contact area. The instantaneous contact point between the wheel and the rail changes constantly in operation, following a so-called "sine course", that is, the contact point oscillates in the transverse direction as the wheel runs along the rail, due to play in the track.

According to the invention there is provided a measuring wheel for measurement of rail-wheel forces, having a rim, a plurality of recesses in the rim extending transversely to the wheel plane and closely spaced in the circumferential direction so as to provide a web or webs between them, and detecting elements located in or on said web or webs and distributed across the width of the measuring wheel rim for detecting forces in the measuring wheel perpendicular to the rail-wheel contact tangent.

By the invention it is possible to provide a measuring wheel which allows the detection of vertical forces between the wheel and the rail in the wheel contact area in the frequency range of 0 to about 10 KHz and allows the determination of the contact point between the wheel and the rail on the running surface of the wheel in the axial direction.

The slowly varying as well as medium and fast-varying forces between the wheel and the rail at the contact point can be directly and exactly detected in the radial direction with the measuring wheel of the invention. This is possible because the detecting elements are now in direct proximity to the point of introduction of force on the wheel and consequently there is no resilience between the point of application of the force and the detecting element which might have a misleading effect on the output signal of the detecting elements particularly with medium and high frequencies. At the same time it is possible to determine the exact localisation of the point of contact between the wheel and the rail in the axial direction, since the detecting elements are distributed over the width of the wheel rim.

The recesses, which may suitably be bores, preferably extend over the entire width of the wheel rim.

It is not necessary for recesses with detecting elements to be arranged over the entire

periphery. The recesses are preferably divided into several groups which are distributed around the periphery of the wheel.

The measuring wheel according to the invention can be in the form of a rail wheel for a rail vehicle, e.g. with a running surface and flange. The usual use of such a measuring wheel is on a rail laid in a track. The forces in the wheel contact area arising between the wheel and the rail are in this case detected directly according to their absolute value and their position at the wheel contact point. However, it is essential for exact measurement that the measuring wheel is calibrated. It is therefore necessary in the examination of several rail wheels with detecting elements arranged in the wheel rim to have each single wheel calibrated.

This difficulty can be avoided if the wheel rim of the measuring wheel of the invention has a rail-head profile so that it can engage with a further wheel having the profile of a rail wheel. As the forces arising in the wheel to be examined, i.e. the rail wheel, also arise in the wheel having the rail-head profile, the vertical forces at the wheel contact point and the position of the point of contact between the wheel and the simulated rail can be exactly detected despite the indirect measurement with a measuring wheel constructed in this way. As the measuring wheel having the rail-head profile carries the detecting elements, various rail wheels can be measured on the testing arrangement without calibration being necessary for each wheel; the wheel having the rail profile is calibrated only once. To exclude subsequent calibration to a great extent, a steel with high abrasion resistance can be used as material for the rail profile portion of the wheel.

An embodiment of the invention is described below by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows a measuring wheel embodying the invention having a rial wheel profile, in semi-axial section;

Fig. 2 shows a side view of a part of the wheel rim of the measuring wheel of Fig. 1; and

Fig. 3 shows a measuring wheel embodying the invention having a rail profile with a rail wheel both in semi-axial section.

The rail wheel 1 represented in Fig. 1 and Fig. 2 is a solid wheel. The invention, however, can also be applied to other rail wheels, e.g. a wheel with shrunk wheel tyres or a wheel in which the wheel tyre is positioned on the wheel rim by interposed rubber blocks.

As shown in Fig. 2, there is a group of bores 3 which extend transversely right through the wheel rim 2 forming between them webs 4. Wire resistance strain gauges 5 are arranged on both sides of each web 4, so that each wire strain gauge 5 responds to the vertical forces at the point of contact of wheel and rail. The wire strain gauges 5 are arranged in three planes perpendicular to the wheel axis. Several such groups of bores can be distributed around the periphery of the wheel.

With this structure and arrangement it is possible to measure the vertical forces at the rail-wheel contact point to a high degree of accuracy and also to localise the exact position of contact between the wheel and rail on the running surface of the wheel. The arrangement of the wire strain gauges ensures that the component of the measured signals attributable to the horizontal forces acting on the wheel is negligibly small in relation to the component attributable to the vertical forces.

The measuring wheel 6 shown in Fig. 3 which is rotatably mounted in a frame (not shown) has a rail-shaped profile at its running surface 7. A rail wheel 8 is also rotatably mounted in the frame and is supported at the vertically highest point of the measuring wheel 6. At least one of the wheels, preferably the measuring wheel 6, is driven. Generally both wheels 6,8 are driven at the same peripheral speed.

Several recesses 10 adjacent to one another in peripheral direction and extending transversely to the wheel plane are provided in the head of the measuring wheel 6, these recesses 10 forming webs between them on which detecting elements 11 in the form of wire strain gauges are arranged. Three such detecting elements 11 are provided in each recess 10. The structure, arrangement and distribution of the detecting elements 11 corresponds with those of Fig. 2. The wheel 6 can thus be used to examine the forces arising at the instantaneous point of contact with the wheel 8.

In the generally known manner, the wire strain gauges may be connected by conductors (not shown) to collector rings (not shown) on the wheel hub which in turn are connected with a measuring means (not shown) which indicates the forces arising at the individual points.

WHAT WE CLAIM IS:

1. Measuring wheel for measurement of rail-wheel forces, having a rim, a plurality of recesses in the rim extending transversely to the wheel plane and closely spaced in the circumferential direction so as to provide a web or webs between them, and detecting elements located in or on said web or webs and distributed across the width of the measuring wheel rim for detecting forces in the measuring wheel perpendicular to the rail-wheel contact tangent.

2. Measuring wheel according to claim 1 wherein each of said recesses extends over the entire width of the rim.

3. Measuring wheel according to claim 1 or claim 2 having two or more of said detecting elements in each recess.

4. Measuring wheel according to any one of claims 1 to 3 having a plurality of groups of said recesses distributed around the wheel periphery, each group having a plurality of said detecting elements distributed across the width of the rim.

5. Measuring wheel according to any one of the preceding claims wherein said recesses are bores extending through the rim.

6. Measuring wheel according to any one of the preceding claims wherein the detecting elements are resistance wire strain gauges.

7. Measuring wheel according to any one of the preceding claims which is a wheel of a rail vehicle.

8. Measuring wheel according to any one of claims 1 to 7 in which the rim has a railhead profile, so that it can be used rotating in contact with a rail vehicle wheel.

9. Measuring wheel substantially as herein described with reference to and as shown in Figs. 1 and 2 of the accompanying drawings.

10. Measuring wheel substantially as herein described with reference to and as shown in Fig. 3 of the accompanying drawings.

11. Rail vehicle having a measuring wheel according to claim 7 or claim 9.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig.1

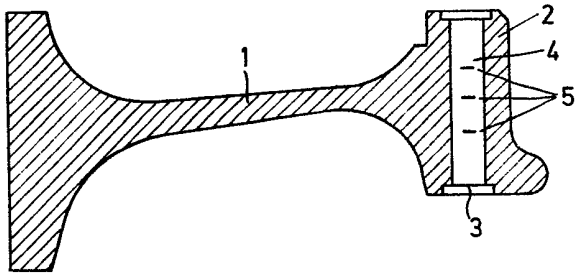
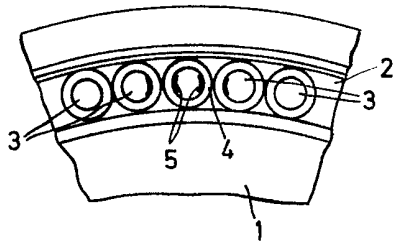


Fig.2



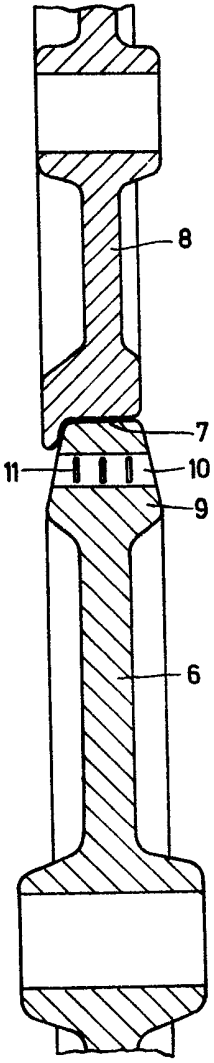


Fig.3