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(54) **Érzékelőcsomag WIM-érzékelőhöz és WIM-érzékelő**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

SENSOR PACKAGE FOR WIM SENSOR AND WIM SENSOR

DESCRIPTION

TECHNICAL FIELD

The invention relates to a sensor package with long design for a WIM (Weigh In Motion) sensor comprising a first receiving plate, a plurality of measuring elements which are arranged equally spaced in a row on the upper side of the first receiving plate an electrode covering all the measuring elements, insulation completely covering the electrode, and a second receiving plate which covers the insulation, wherein each receiving plate consists of a plurality of receiving elements, the end faces of which are juxtaposed in a row.

PRIOR ART

WIM sensors are sensors between one and several metres long that are installed in the road to measure the dynamic ground reaction forces of vehicles, in order to determine their weight. An essential element of the sensor is the aluminium hollow profile, in which a preloaded sensor package is installed. Mountings provided at the top and bottom ensure an optimal flow of force through the measuring element. The hollow profile comprises a tube part, which is responsible for initial tension and sealing the measuring element. A known hollow profile for such purposes is described for example in EP0654654.

The measuring elements in the sensor packages are typically piezoelectric. However, other measuring principles, such as resistive, piezoresistive, capacitive, optical or magneto-elastic are also possible. In order to be able to measure using the entire length of the sensor, the measuring elements are arranged at regular intervals along the sensor length. They are spaced at distances of a few centimetres. A sensor package comprises steel receiving plates, one each at the top and bottom, between which an insulation and an electrode foil are arranged. The measuring elements are arranged between the electrode foil and the adjacent receiving plate. Steel receiving plates are necessary to guarantee the required strength and evenness of the quartz receiving. To ensure that measurements can be taken with the same accuracy and sensitivity over the entire length of the WIM sensors, all of the measuring elements must be exposed to precisely the same tension conditions in the hollow profile. This requires a high degree of accuracy not only in the manufacture of the hollow profiles, but also in the sensor packages, the thickness of which must be uniform over the entire length thereof, within a narrow tolerance.

The production of steel receiving plates in the desired length from one to several metres and the required thickness is extremely difficult. The required surface tolerances such as flatness, parallelism, thickness, surface roughness, etc., as the quartz receiving can only be obtained by employing a grinding process that is almost impossible for such lengths, and at all events involves huge effort. The receiving plates are prone to bending and twisting.

A WIM sensor consisting of a plurality of single modules that are aligned to each other, wherein each element includes a sensor that is read out separately, is known from EP 0892259. These individual modules are mounted on a bottom rail. It has been found that the construction is very complicated, because each element

must be manufactured, tensioned and sealed individually. Since the WIM sensors are also exposed to environmental influences in the street, the seal loses its sealing quality after a certain time, leading to the failure of individual sensors.

A WIM sensor system with individual elements that have been inserted in a tube is described in US 5265481. It has proven difficult to insert the sensor elements in the closed tube.

SUMMARY OF THE INVENTION

The object of the present invention is to describe a sensor package of the type described in the introduction for WIM sensors of which kind, and which satisfies the required tolerance, but is less expensive to produce and overcomes the disadvantages mentioned. A correspondingly inexpensive WIM sensor is also to be indicated.

This object is solved by the features of independent claims 1 and 9.

In the configuration according to the invention, adjacent receiving elements are connected to each other by form-fitting connections at their respective end faces. This method of connecting the receiving elements makes it possible to pull the sensor package into the hollow profile. This in turn represents significant advantages for handling and assembly.

The inventive WIM sensor includes a sensor package according to the invention. When installed for use in a road, a force is exerted perpendicularly on the WIM sensor from the road surface.

The receiving elements of the sensor package according to the invention are correspondingly much shorter than a receiving plate of a sensor package according to the prior art, which is constructed as a single part.

These relatively small receiving elements can be produced in large quantities and inexpensively with a suitable tool. For this, they stamped out under the requisite precision tolerance conditions and then ground inexpensively in standardised procedures. A row of receiving elements is easily formed by juxtaposing a number of receiving elements up to the desired length.

It is much easier and cheaper to produce a large number of small receiving elements with strict specifications regarding flatness and parallelism than to manufacture a few receiving plates one or more metres in length that satisfy the same specifications regarding surface quality. Whereas long receiving plates have not proved to be very difficult to produce and consequently the selection of materials that can be used to make them is severely limited, with short receiving elements it is not difficult to satisfy the stringent requirements with desired materials such as stainless steel.

Another significant advantage of the invention is the flexibility in the length of the sensor, since the receiving elements, which are now shorter, can be assembled to the desired length. This reduces the need for product variety and simplifies assembly. It is also possible to build WIM sensors of different lengths, even longer than 2 m, which was not previously possible.

Further variations of the invention are described in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWING

In the following, the invention will be explained in greater detail with reference to the drawing. In the drawing:

- Fig. 1 shows a cross section of a WIM hollow profile including a sensor package;
Fig. 2 shows a perspective view of a cross-section of a road with a WIM sensor installed;
Fig. 3 is an enlarged view of a cross section of a sensor package for a WIM sensor;
Fig. 4 is a side view of a longitudinal section of a sensor package according to the invention as shown in Fig. 3;
Fig. 5 is a top view of surface A-A of a longitudinal section of an inventive sensor package shown in Fig. 3;
Fig. 6 is a perspective view of a receiving element in the inventive configuration.

WAYS OF CARRYING OUT THE INVENTION

In the following, the invention will be described in greater detail with reference to the figures. The same reference numerals will be used consistently to refer to the same items.

In Figure 1, a hollow profile 3 of a WIM (Weigh in Motion) sensor 1 is shown in cross section. The height and width of such hollow profiles 3 are usually between 30 and 70 mm, while the length thereof, not shown here, is typically between 1m and 4m. Consequently, such hollow profiles 3 may be described as long in comparison to the cross-sectional dimensions thereof.

Hollow profile 3 comprises a central tube 4 and two mountings 5 arranged opposite one another inside the tube. A sensor package 6 is clamped between said mountings 5. Tube 4 ensures that the initial tension is exerted uniformly on sensor package 6 and that sensor package 6 is sealed over the entire length of WIM sensor 1. In operation, a force is absorbed by hollow profile 3 from the outer, non-designated plates and transferred to mountings 5 in tube 4. From there, the force acts on sensor package 6, which is configured as a stack, and is applied to all of the layers thereof, particularly via measuring elements 10 that are arranged flat in the sensor package.

Figure 2 shows a perspective cross section of a road 2, which has a WIM sensor 1 incorporated therein. The upper side of WIM sensor 1 is arranged flush with road surface 2. WIM sensor 1 is aligned transversely to the direction of traffic, which is indicated by an arrow, so that vehicles cross over WIM sensor 1 when passing. If required, several WIM sensors 1 may be arranged in a line so as to cover the entire lane. The weight of passing vehicles can then be determined as they pass with WIM sensors 1. The captured data is forwarded to evaluation stations via links provided for this purpose, but not shown.

To ensure that the weight of a vehicle can always be determined correctly, sensor 1 must be configured identically over its entire length. In particular, the initial tension on the centrally clamped sensor package 6 must match precisely defined specifications at all points.

Figure 3 is an enlarged view of a sensor package 6 of a WIM sensor 1 in cross-section. A side view of a longitudinal section of such a sensor package 6 corresponding to the configuration of the invention is shown in Figure 4.

Sensor package 6 comprises a first receiving plate 7, on which a plurality of measuring elements 10 is disposed. Said measuring elements 10 are arranged equidistantly from each other in a row on upper surface 9 of first receiving plate 7. Said measuring elements 10 are covered directly or indirectly by an electrode 11. Said electrode 11 in turn is completely covered by an insulation 12, which in particular may be configured as a foil or a film. Finally, a second receiving plate 8 covers insulation 12 directly or indirectly, and is the last essential

component of sensor package 6.

The components of sensor package 6 listed in the above, in particular the two receiving plates 7, 8, measuring elements 10 and electrode 11 with insulation 12, are all arranged flat, one on top of the other on the respective surfaces thereof, which arrangement demands extremely high quality with regard to flatness, evenness and surface roughness. Suitable dimensions for each of the various surface qualities and/or thicknesses are defined by close tolerances.

Figure 4 shows that each receiving plate 7, 8 of sensor package 6 according to the invention consists of a plurality of receiving elements 13, which are disposed in a row 15 with the end faces 14 thereof of adjacent to each other. Unlike the prior art, receiving plates 7, 8 are thus not constructed as a single piece, but are still adjacent to each other. The row of receiving elements 13 is as long as the entire length of sensor package 6.

In particular, all receiving elements 13 of a row 15 are identical to each other. This particularly applies to the choice of material and the surface quality of receiving elements 13. And production costs may be lowered further still if receiving elements 13 are also identical with respect to all dimensions thereof.

Receiving members 13 are preferably made from stainless steel. This material is ideal in terms of hardness and strength, the properties required to enable machining of the surfaces, and corrosion resistance. Conventional, single-part receiving plates 7, 8 cannot be made from stainless steel.

The construction according to the invention is shown in Figure 5. In this embodiment, inner end faces 14 of receiving elements 13 of at least one row have profiles 16 that engage in form fitting manner in profile 16 of adjacent end faces 14 of adjacent receiving elements 13. This allows positive locking connections 17 to be made between receiving elements 13, thereby transforming row 15 of receiving elements 13 into a chain. This has the advantage that the sensor package may also optionally be pulled a between mountings 5 of a hollow profile 3. For this purpose, a fastening element may be attached to the outer profile 16 of leading receiving element 13 to enable it to be pulled.

Figure 6 also shows a perspective view of a receiving element 13 according to the invention, with slightly different proportions. This figure also shows that a chain may be created from a plurality of said receiving elements 13 by form fitting connections on profiles 16 of end faces 14. Connecting region 17 is also indicated by a dashed line in Figure 4. Measuring elements 10 should not be arranged in this connecting region 17.

Receiving elements 13 according to the invention are preferably 60 to 300 mm long, particularly 100 to 150 mm, 5 to 25 mm wide, particularly 8 to 15 mm, and 1 to 6 mm thick, particularly 2 to 2.5 mm. These sizes have proven favourable for simple production. In this way multiple measuring elements 10 can be arranged on each receiving member 13, preferably arranged at a distance of 1 to 10 cm from each other.

According to the invention, the tolerances for thickness and parallelism of all receiving members 13 are not more than 30 μm . This ensures that the total thickness of sensor package 6 satisfies the requirements for measurement accuracy.

In addition, the tolerances for surface flatness of receiving elements 13, facing towards or away from measuring elements 10, must not exceed 50 μm . Both of these inner surfaces face toward measuring elements 10 and must therefore be machined very accurately. When installed, the two outer surfaces are positioned on top of mountings 5 of hollow profile 3, which must also satisfy requirements in respect of flatness.

According to the invention, the roughness value for surfaces 9 of receiving elements 13 adjacent to

measuring elements 10 must not exceed 1.6 Ra. This is important to ensure that measuring elements 10 also have a defined, flat support surface.

Preferably, all receiving elements 13 are of identical design. This applies to choice of material, the dimensions and all tolerances of surfaces and thicknesses. This has the advantage that it is not necessary to distinguish between the receiving elements 13 for the first and second receiving plates 7, 8. The same tools can be used for all receiving elements 13. They can all also undergo the same processing steps to obtain the required surface qualities. According to the invention, both surfaces on which receiving elements 13 ultimately rest are of identical construction. In this way, a receiving element 13 cannot be inadvertently fitted the wrong way round during assembly of a sensor package 6 according to the invention.

The invention also relates to a WIM sensor 1 comprising a hollow profile 3 with a tube 4, in which two mountings 5 are arranged facing one another, between which a sensor package 6 according to the invention is arranged under initial tension. Such a WIM sensor 1 is shown in Figure 1, although this figure does not show that receiving plates 7, 8 each consisting of a plurality of receiving elements 13 engage with one another in form fitting manner. Such WIM sensors 1 are significantly less expensive than conventional WIM sensors 1, because the sensor package 6 according to the invention which is used therein is less expensive.

LIST OF REFERENCE NUMERALS

- 1 WIM (Weigh in Motion) sensor, drive-over sensor
- 2 Road
- 3 Hollow profile
- 4 Tube
- 5 Mounting
- 6 Sensor package
- 7 First receiving plate
- 8 Second receiving plate
- 9 Upper side of first receiving plate
- 10 Measuring element, measurement quartz
- 11 Electrode
- 12 Insulation
- 13 Receiving element
- 14 Receiving element end face
- 15 Row of receiving elements
- 16 Profile of an end face for form fitting connection
- 17 Form fitting connection, connection area

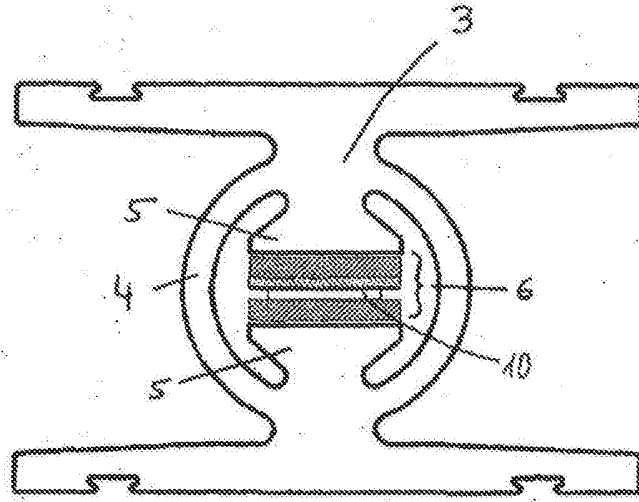
ÉRZÉKELŐCSOMAG WIM-ÉRZÉKELŐHÖZ ÉS WIM-ÉRZÉKELŐ

SZABADALMI IGÉNYPONTOK

1. Hosszú elrendezésű (6) érzékelőcsomag egy (1) WIM-érzékelő (Weigh in Motion, dinamikus –mozgás közbeni - súlymérés) számára, mely tartalmaz egy (7) első alaplapot, több (10) mérőelemet – melyek egyenlő távolságban egy sorban elosztva találhatóak a (7) első alaplapon (9) felső oldalán –, egy az összes (10) mérőelemet közvetlenül vagy közvetve átfedő (11) elektródát, egy a (11) elektródát teljesen átfedő (12) szigetelést, valamint egy (8) második alaplapot, mely a (12) szigetelést közvetlenül vagy közvetve lefedi, mikoris mindegyik (7, 8) alaplapon több darab (13) olyan befogadó elemből áll, melyek a (14) homlokoldalukon egymással szomszédságban egy (15) sorban helyezkednek el, azzal jellemezve, hogy a (13) befogadó elemek a (14) belső homlokoldalukon legalább egy (15) sornyit tartalmaznak az olyan (16) profilokból, melyek a szomszédos (13) befogadó elemek közeli (14) homlokoldalainál a (16) profilokba alakzáróan belefognak.
2. Az 1. igénypont szerinti érzékelőcsomag, azzal jellemezve, hogy egy (15) sorban az összes (13) befogadó elem egymással azonos.
3. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy a (13) befogadó elemek nemesacélból készülnek.
4. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy a (13) befogadó elemek 60 és 300 mm közötti hosszúsággal, különösen pedig 100 és 150 mm közötti hosszúsággal, illetve 5 és 25 mm közötti szélességgel, különösen pedig 8 és 15 mm közötti szélességgel, továbbá 1 és 6 mm közötti vastagsággal, különösen pedig 2 és 2,5 mm közötti vastagsággal rendelkeznek.
5. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy az összes (13) befogadó elem esetében a vastagsági és a párhuzamossági tűrés legfeljebb 30 µm-t tesz ki.
6. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy a (13) befogadó elemek esetében azon felületek egyenletességi tűrése legfeljebb 50 µm-t tesz ki, melyek a (10) mérőelemek felé vagy attól elfelé néznek.
7. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy a (13) befogadó elemek azon felületeinél, melyek a (10) mérőelemekkel határosak, az érdesség mértéke nem haladja meg a "Ra 1.6" értéket.
8. A fenti igénypontok bármelyike szerinti érzékelőcsomag, azzal jellemezve, hogy az összes (13) befogadó

elem azonos kialakítású.

9. Az olyan (1) WIM-érzékelő, mely tartalmaz egy (4) csővel egy (3) üreges profilt és két, azon belül szemben fekvően elhelyezkedő olyan (5) tartóeszközt, melyek között egy a fenti igénypontok bármelyike szerinti (6) érzékelőcsomag előfeszítés alatt állóan helyezkedik el.



← 1

Fig. 1

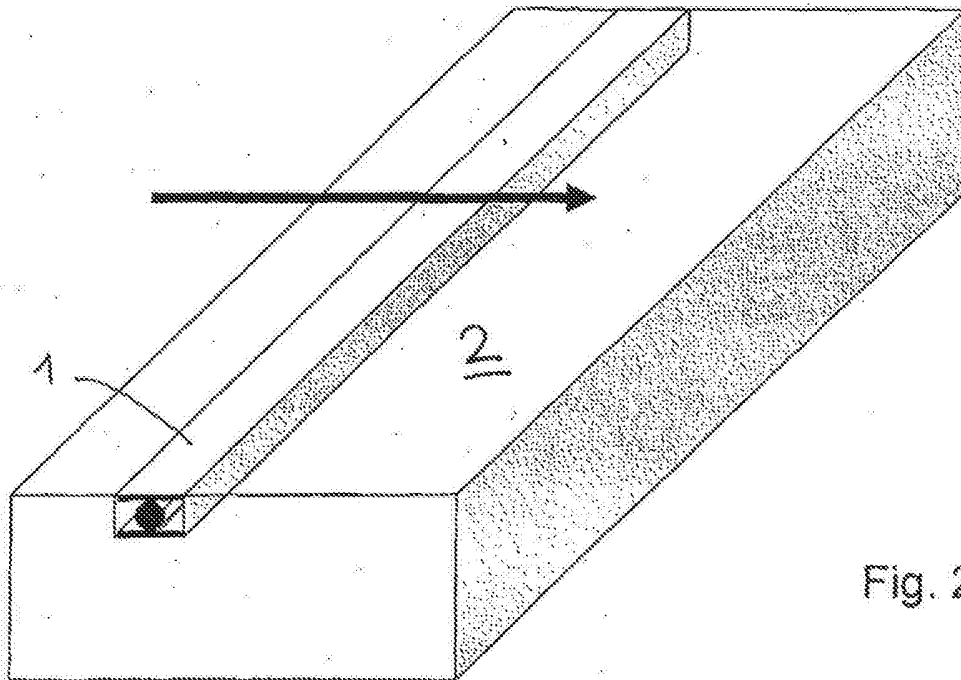


Fig. 2

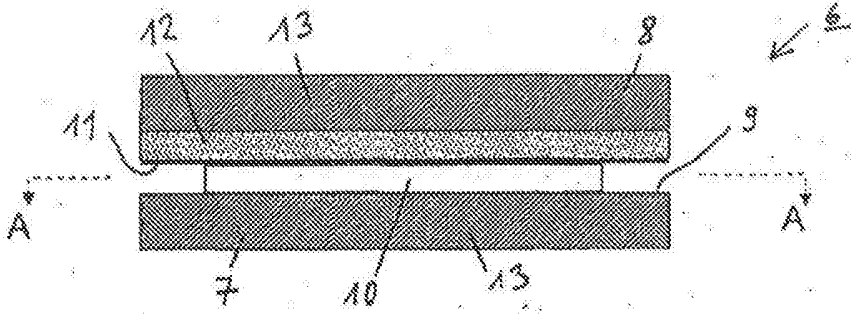


Fig. 3

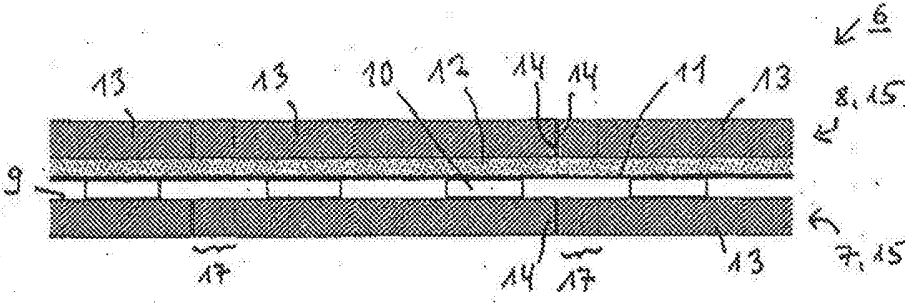


Fig. 4

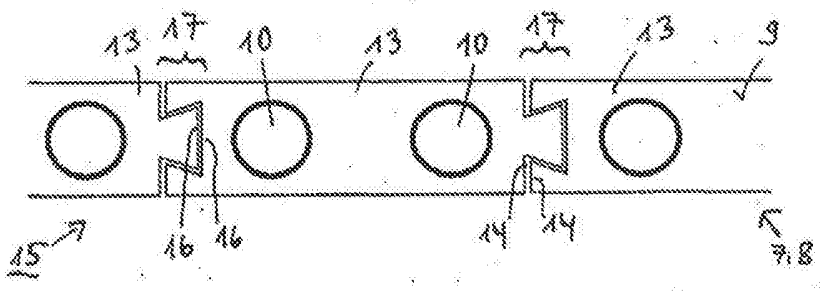


Fig. 5

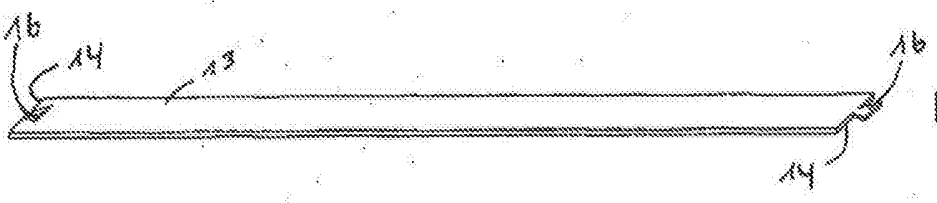


Fig. 6