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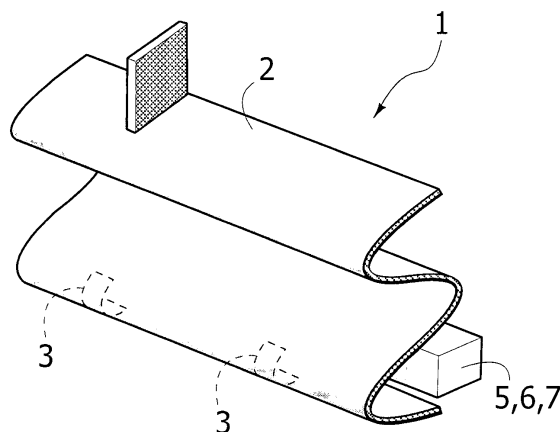
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(54) **Road barrier structure with an integrated system for energy generation and detection and classification of collisions**

(57) A road-barrier structure is provided with a plurality of piezoelectric modules (3) integrated in a wall (2) thereof and distributed along the latter. The wall (2) is shaped and set in such a way as to be subject to vibrations as a result of the passage of motor vehicles along the road on which the road barrier is installed. The piezoelectric modules (3) are arranged and oriented for exploiting said vibrations in an optimal way in order to produce electrical energy. Furthermore, the piezoelectric modules (3) are arranged in such a way as to be able also to perform, together with the function of generators, also the function of deformation sensors, designed to detect collisions against the road barrier. The modules (3) are connected to an electronic control unit (4) programmed for processing the signals at output from the piezoelectric modules (3) and classifying the detected collisions against the road barrier on the basis of a pre-determined scale of seriousness. The control unit (4) is supplied with the energy generated by the piezoelectric modules (3). The electronic control unit (4) moreover includes wireless transmission means (9) for transmitting the information regarding the data detected.

FIG. 1



Description

[0001] The present invention relates to a road-barrier structure provided with piezoelectric generating means, which are arranged in such a way as to be activated and generate electrical energy as a result of the passage of motor vehicles along the road where the road barrier is installed.

[0002] A road-barrier structure of this type has been described and illustrated in the document No. EP 1 840 982 A1 filed in the name of the present applicant. It should also be noted that in the art control systems are known that include detectors of collisions associated to road-barrier structures (see, for example, the documents Nos. FR-A-2 721 129, DE-A-4 100 183, JP-A-10069594, EP-A-1 167 629, JP-A-2000 227989).

[0003] The object of the present invention is to provide a road-barrier structure, which as compared to the known solutions presents the advantage of being in the form of an integrated structure that is easy and fast to install and is designed to perform simultaneously a multiplicity of functions that cannot be achieved together by any of the known devices.

[0004] In order to achieve said object, the subject of the invention is a road-barrier structure of the type indicated at the start of the present description and moreover **characterized in that** the aforesaid piezoelectric generating means comprise a plurality of piezoelectric modules integrated in a wall of said structure and distributed along it, said wall being shaped and set in such a way as to be subject to vibrations as a result of the passage of motor vehicles along the road, and said piezoelectric modules being arranged and oriented for exploiting in an optimal way said vibrations in order to produce electrical energy, said road-barrier structure being moreover **characterized in that** the aforesaid piezoelectric modules are arranged in such a way as to be designed to perform, together with the function of generators, also the function of deformation sensors designed to detect collisions against the road barrier, said piezoelectric modules being connected to an electronic control unit programmed for processing the signals at output from said sensor means and classifying the detected impact against the road barrier on the basis of a predetermined scale of seriousness, said control unit being supplied with energy generated by said piezoelectric modules.

[0005] Thanks to the characteristics referred to above, the road-barrier structure according to the invention has an integrated unit, incorporating within it the piezoelectric modules, to the advantage of the simplicity and rapidity of installation of the system. As mentioned, the piezoelectric modules prearranged in the structure, in association with the electronic control unit, are able to perform both the function of generators, exploiting the vibrations to which the structure is subject as a result of the passage of motor vehicles along the road (produced by the vibrations of the ground and/or by the displacement of air) as well as the function of detecting and classifying the pos-

sible collisions.

[0006] In the preferred embodiment, the aforesaid electronic control unit is associated to wireless transmission means for transmitting information regarding the data detected.

[0007] According to a further preferred characteristic of the invention, the electronic control unit is connected to a plurality of sensors of environmental parameters, such as, for example, a temperature sensor, a humidity sensor, a light sensor, and a smog sensor, said sensors also being carried on said road-barrier structure and being supplied with the energy generated by said piezoelectric modules. Also said sensors of environmental parameters are equipped with wireless transmitting means designed to transmit information on the environmental parameters detected.

[0008] The electronic control unit is able to carry out the aforesaid classification of the collisions detected since the piezoelectric modules produce electrical energy in a way proportional to the deformation to which they are subjected. Below a minimum threshold, the deformation is the one due simply to the passage of a motor vehicle along the road. The system is hence also usable for making a count of the motor vehicles travelling.

[0009] Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a schematic perspective view of a sectioned portion of a road-barrier structure according to the invention; and
- Figure 2 is a block diagram of the structure according to the invention.

[0010] In Figure 1, the reference number 1 designates as a whole a wall made of corrugated sheet metal forming part of a road-barrier structure according to the invention. The drawings do not show the complete structure, which can be made in any known way, with columns designed to be fixed to the road bed, which support in turn the ends of sectional elements of the type a portion of which is visible in Figure 1.

[0011] According to an important characteristic of the invention, distributed along the wall of the structure 1, designated as a whole by 2, is a plurality of piezoelectric modules 3. The specific structure of each module 3 is not described or illustrated herein, since it can be made in any known way and in so far as, taken in itself, it does not fall within the scope of the present invention; moreover, the elimination of said details from the drawings renders the latter faster and easier to understand.

[0012] It is important, according to the invention, that the arrangement and conformation of the wall 2, as well as the arrangement and conformation of the piezoelectric modules 3, should be such as to cause said piezoelectric modules 3 to undergo a deformation as a result of vibrations to which the wall 2 is subject as a result of the pas-

sage of motor vehicles along the road on which the road barrier is mounted. The vibrations are prevalently due to the transmission of the vibrations of the road surface generated by the passage of motor vehicles, which are transmitted to the wall 2 via the columns (not illustrated) that connect it to the ground. However, the vibrations may also be in part due to the displacement of air generated by the passage of the motor vehicles.

[0013] The piezoelectric modules 3 are able to generate electrical energy in a way proportional to the deformation to which they are subjected.

[0014] In the diagram of Figure 2 it is shown how an electronic control unit 4 (it may be envisaged to provide one of said units for each stretch of road barrier of pre-set length) receives the signals emitted by the piezoelectric modules 3 distributed along said pre-set stretch of road barrier and uses them to supply a series of electrical devices prearranged and incorporated in the very structure of the road barrier.

[0015] Provided in the preferred embodiment is a WSN (Wireless Sensor Network) made up of sensors 5, 6, 7 of environmental parameters, such as, for example, a temperature sensor 5, a humidity sensor 6, a sensor 7 for light or smog or some other parameter, which are equipped, in a way in itself known, with wireless transmitting means designed to issue wireless signals 8 to a receiving station (not illustrated) in order to transmit information on the environmental parameters detected. The aforesaid WSN operates with the energy generated by the aforesaid piezoelectric modules 3 so that the unit according to the invention is altogether autonomous.

[0016] Once again according to an important characteristic of the invention, the electronic control unit 4 uses the signals issued by the piezoelectric modules 3 also for classifying the deformations to which said modules are subject, according to a series of pre-set threshold values. Below a lower threshold value, the deformations are identified as due simply to the vibrations transmitted by the passage of a motor vehicle. The signals below said threshold value can then be used to make a count of the number of the motor vehicles travelling along the road. Above upper threshold values, the deformations to which the piezoelectric modules are subject are identified as due to collisions. The degree of the collision can be classified according to seriousness, where a distinction is made between minor impact, caused for example by pedestrians, and impact of greater seriousness. Above an upper threshold value, considered as identifying a serious collision, the system can be prearranged for generating an alarm. Also in order to transmit the information on the count of the vehicles passing and on the collisions, the unit 4 is associated to a wireless transmitter 9, which is able to issue a wireless signal 10 containing the aforesaid information.

[0017] As already mentioned, the structure according to the invention presents the advantage of having the piezoelectric modules 3 integrated within it, to the advantage of the ease and rapidity of installation. Unlike known

devices, the device according to the invention is **characterized in that** it is multifunctional, providing both for generation of energy, which is used both to enable the autonomous supply of the WSN and to detect and classify the types of impact, including the function of counting the motor vehicles travelling along the road.

[0018] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what has been described and illustrated herein purely by way of example, without thereby departing from the scope of the present invention.

15 Claims

1. A road-barrier structure, provided with piezoelectric generating means (3) arranged in such a way as to be activated and generate energy as a result of the passage of motor vehicles along the road where the road barrier is installed, said structure being **characterized in that** said piezoelectric generating means comprise a plurality of piezoelectric modules (3) integrated in a wall (2) of said road-barrier structure (1) and distributed along it, said wall (2) being shaped and set in such a way as to be subject to vibrations as a result of the passage of motor vehicles along the road, and said piezoelectric modules (3) being arranged and oriented for exploiting said vibrations in order to produce energy, said road-barrier structure being moreover **characterized in that** said piezoelectric modules are arranged in such a way as to be designed to perform, together with the function of generators, also the function of deformation sensors designed to detect collisions against the road barrier (1), said piezoelectric modules (3) being connected to an electronic control unit (4) programmed for processing the signals at output from said sensor means (3) and classifying the impact detected against the road barrier on the basis of a predetermined scale of seriousness, said control unit being supplied with energy generated by said piezoelectric modules (3).
2. The road-barrier structure according to Claim 1, **characterized in that** said electronic control unit (4) includes wireless transmission means (9) for transmitting information regarding the impact detected.
3. The road-barrier structure according to Claim 1 or Claim 2, **characterized in that** said electronic control unit (4) is connected to a plurality of sensors (5, 6, 7) of environmental parameters, such as for example a temperature sensor (5), a humidity sensor (6), a light sensor (7) or a smog sensor, said sensors (5, 6, 7) also being carried on said road-barrier structure (2) and being supplied with the energy generated by said piezoelectric modules (3), said sensors

(5, 6, 7) of environmental parameters being moreover associated to wireless transmitting means (8) designed to transmit information on the environmental parameters detected.

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4. The road-barrier structure according to Claim 1, **characterized in that** said electronic control unit (4) is programmed for making a count of the motor vehicles travelling along the road on the basis of the signals issued by said piezoelectric modules (3).

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5. The road-barrier structure according to Claim 1, **characterized in that** said unit is associated to means for generating an alarm signal, which are activated when an impact is detected having an energy higher than a predetermined threshold.

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FIG. 1

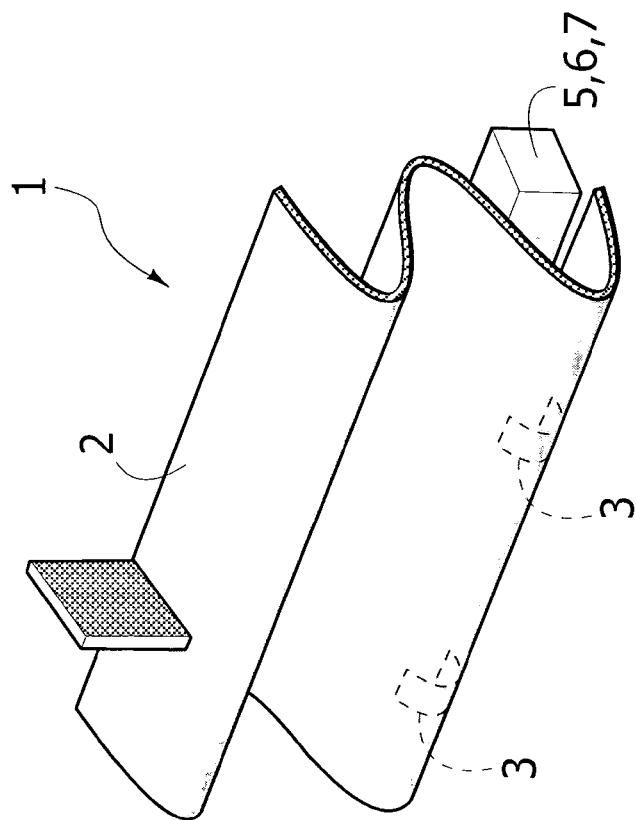
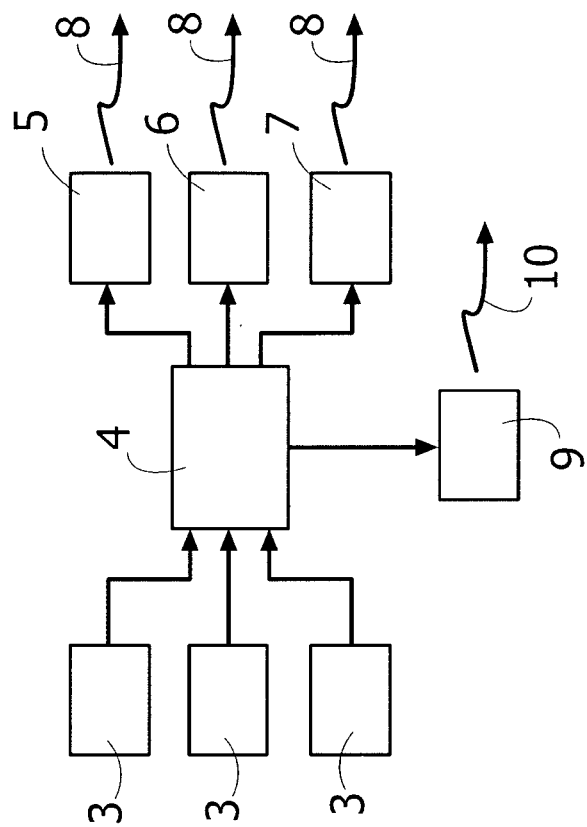


FIG. 2





EUROPEAN SEARCH REPORT

Application Number
EP 09 42 5180

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 04 068499 A (NIPPON ELECTRIC ENG) 4 March 1992 (1992-03-04) * abstract; figure *	1	INV. E01F9/03 G08G1/16
A	DE 10 2006 005371 A1 (HEINTZMANN SICHERHEITSSYSTEME [DE]) 16 August 2007 (2007-08-16) * paragraphs [0027], [0049] - [0056]; figures 1,2 *	1	
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A	JP 2003 253630 A (JIGYO SOZO KENKYUSHO KK; USC CORP) 10 September 2003 (2003-09-10) * abstract; figures 1-3 *	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E01F G08G
3	Place of search Munich	Date of completion of the search 28 October 2009	Examiner Flores Hokkanen, P
CATEGORY OF CITED DOCUMENTS		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	
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 09 42 5180

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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28-10-2009

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REFERENCES CITED IN THE DESCRIPTION

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