VEHICLE SEAT LOAD DETECTION DEVICE

Inventors: Wataru Sakuma, Nagoya-shi (JP);
Makoto Ono, Kariya-shi (JP)

Correspondence Address:
WENDEROTH, LIND & PONACK, L.L.P.
2033 K STREET N. W., SUITE 800
WASHINGTON, DC 20006-1021

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ABSTRACT
A magnet is attached to springs of a seat cushion. A connecting member is attached to side portions of a seat cushion frame. A magnetic sensor having a magnetic impedance element is fixed on the connecting member while being positioned right below the magnet. By seating of an occupant on the seat cushion, springs are downwardly bent to bring the magnet closer to the magnetic sensor and to thereby change the magnetic field of the magnet detected with the magnetic sensor. The load applied by an occupant to the seat cushion is detected on the basis of the change of the magnetic field.
VEHICLE SEAT LOAD DETECTION DEVICE

CROSS REFERENCE TO RELATED APPLICATION


TECHNICAL FIELD

[0002] The present invention relates to a vehicle seat load detection device for detecting a load applied to a vehicle seat.

BACKGROUND

[0003] There has been a need to determine the existence/nonexistence of an object on a vehicle seat by detecting a load applied from an occupant to the vehicle seat in order to control the operation of an airbag according to the existence/nonexistence of an occupant and the size of the physical constitution of the occupant. Springs which are bendable members incorporated in the seat cushion of the vehicle seat are ordinarily displaced by several ten millimeters by bending caused by seating. Accordingly, detection of the load applied from an occupant to the vehicle seat on the basis of the displacement of the bendable members incorporated in the vehicle seat essentially requires using a sensor capable of detecting the amount of relative displacement through several ten millimeters between the bendable members and a fixed member. If this detection is realized by means of a conventional displacement sensor such as a magnetic sensor in a simple manner, it is necessary to use a considerably large magnetism generator or dispose a plurality of sensors for measurement of the displacement in one place. A device including such a generator or sensors cannot be mounted in the vehicle seat.

[0004] A conventional art provided to solve this problem is known, which relates to a load detection device for detecting a load applied to a vehicle seat by converting the amount of bending of a seat cushion caused by seating into a minuscule displacement by means of a converting member, and by detecting this minuscule displacement with a strain gauge (see, for example, Japanese Patent Laid-Open No. 2005-49272, pp. 4-6, FIGS. 1 through 6, and a published Japanese translation of a PCT application No. 2001-512573, pp. 7-8, FIG. 3). [0005] In the above-described conventional art, however, there is a need to use a special displacement amount converting member connected to a spring member in the vehicle seat for the purpose of converting a displacement of the spring member by seating into a minuscule displacement, resulting in an increase in the number of components and an increase in manufacturing cost.

SUMMARY

[0006] In view of the above-described circumstances, an object of the present invention is to provide a low-cost vehicle seat load detection device having a reduced number of component parts.

[0007] In a vehicle seat load detection device according to the present invention, a flexible member is bent by an amount corresponding to a load applied to a vehicle seat to change the distance between a magnetism generator and a magnetic sensor having a magnetic impedance element and to thereby change a magnetic field generated by the magnetism generator, and the load applied to the vehicle seat is detected on the basis of the detected change of the magnetic field.

[0008] The magnetic sensor having a magnetic impedance element has high magnetic sensitivity and is capable of detecting the displacement of the magnetism generator positioned at a distance of several ten millimeters therefrom by detecting the change of the magnetic field. Therefore, the vehicle seat load detection device of the present invention is capable of directly detecting the load applied to the vehicle seat from the amount of bending of the flexible member without using any special displacement amount converting member or the like.

[0009] According to illustrative aspects of the present invention, arrangements described below are preferred.

[0010] (1) The magnetic sensor is attached to a fixed member to ensure that the magnetic sensor to which a harness, an electronic circuit or other components are connected is not moved by occupant’s seating or the like, and that the durability of the electrical connection therebetween can be improved. Also, the facility with which furnishing with the harness connected to the magnetic sensor is performed is improved and the facility with which the magnetic sensor is attached to the vehicle seat is also improved.

[0011] (2) A supporting member for supporting the magnetism generator is provided on a plurality of spring members; a connecting member is stretched below the supporting member between two side portions of a seat frame facing each other so as to be opposed to the supporting member through a predetermined distance; the magnetic sensor is fixed on the connecting member; and the supporting member is downwardly bent together with the plurality of spring members by seating on the vehicle seat to bring the magnetism generator closer to the magnetic sensor. Thus, the distance between the magnetism generator and the magnetic sensor is changed by bending of the plurality of spring members to enable the load applied to the vehicle seat to be detected with improved accuracy.

[0012] The vehicle seat load detection device of the present invention is capable of directly detecting the load applied to the vehicle seat from the amount of bending of the flexible member. Therefore there is no need to provide any special displacement amount converting member or the like. Thus, the number of component parts of the vehicle seat load detection device can be reduced and the vehicle seat load detection device can be easily manufactured at a reduced cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a perspective view of a vehicle seat in an illustrative aspect of the present invention;

[0014] FIG. 2 is a perspective view of a state in which a cushioning material is removed from the vehicle seat shown in FIG. 1;

[0015] FIG. 3 is a sectional view taken along line A-A in FIG. 2;

[0016] FIG. 4 is an enlarged view of a portion shown in FIG. 3;

[0017] FIG. 5 is a diagram schematically showing the vehicle seat load detection device in the illustrative aspect of the present invention;
FIG. 6 is a sectional view showing a state in which the spring shown in FIG. 3 is bent;

FIG. 7 is a graph showing the relationship between the amount of bending of the springs and the output voltage from the magnetic sensor;

FIG. 8 is a diagram schematically showing an example of modification of the device in the illustrative aspect of the present invention; and

FIG. 9 is a diagram schematically showing an example of modification different from that shown in FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED ILLUSTRATIVE ASPECTS

Illustrative aspects of the present invention will be described with reference to FIGS. 1 to 7.

A vehicle seat load detection device 5 according to an illustrative aspect of the present invention is attached to a vehicle seat 1. The vehicle seat 1 has a seat cushion 2 and a seat back 3 (see FIG. 1). The seat cushion 2 is mounted on a floor panel (not shown) of a vehicle by means of lower rails 4. The seat back 3 is mounted on the seat cushion 2. The seat back 3 can be turned along the vehicle front-rear direction.

The seat cushion 2 on which an occupant sits has a seat cushion frame 22 (corresponding to the fixed member and the seat frame of the present invention). The seat cushion frame 22 supports a cushioning material. The seat cushion frame 22 is fixed on upper rails 21 movably engaging with the lower rails 4 (see FIG. 2). The seat cushion frame 22 has left and right side portions 22a facing each other. Rear ends of the side portions 22a are connected to each other by a connecting shaft 23. Ends of a plurality of springs 24 (corresponding to the flexible member and the spring members of the present invention) are respectively attached to a front side portion 22b of the seat cushion frame 22 and the connecting shaft 23. Each of the plurality of springs 24 extends in the front-rear direction. Each spring 24 is downwardly bent by a load applied thereto, for example, when an occupant sits on the vehicle seat 1 and is, therefore, displaceable relative to the seat cushion frame 22 not bendable under any load.

The seat back 3 has a seat back frame 31 supporting a cushioning material as in the case of the seat cushion 2. Ends of a plurality of spring members 32 are attached to left and right side portions of the seat back frame 31 (see FIG. 2).

The plurality of springs 24 of the seat cushion 2 are connected to each other by a magnetism generator supporting member 51 (corresponding to the supporting member of the present invention) constituting the vehicle seat load detection device 5 of the present invention (see FIG. 3). The magnetism generator supporting member 51 is a non-magnetizable material, e.g., a nonferrous metal or a synthetic resin. The magnetism generator supporting member 51 has a base 51a generally in the form of a plate. Curled attachment portions 51b which can be attached to the springs 24 with a certain degree of freedom are formed at opposite ends of the base 51a. The attachment portions 51b of the magnetism generator supporting member 51 are located at the side ends. Therefore the magnetism generator supporting member 51 engage with the plurality of springs 24.

A yoke 51c formed from a material having a high permeability, e.g., a metal is incorporated in a central portion of the base 51a. A plurality of supporting projections 51d extend downward from the central portion of the base 51a. A magnet 52 (corresponding to the magnetism generator of the present invention) is fitted between the supporting projections 51d. Claw portions 51f of the supporting projections 51d engage with the magnet 52 to prevent the magnet 52 from coming off (see FIG. 4). The magnet 52 is a permanent magnet for generating a magnetic field and has a cylindrical shape. The magnet 52 is supported on the base 51a so that the magnetic poles are vertically oriented. The upper surface of the magnet 52 abuts against the lower surface of the yoke 51c. The magnet 52 is surrounded by the supporting projections 51d extending downward.

A connecting member 22c in the form of a plate corresponding to the fixed member of the present invention is stretched between the side portions 22a of the seat cushion frame 22 facing each other. The connecting member 22c is placed below the magnetism generator supporting member 51 at a predetermined distance from the same so as to face the magnetism generator supporting member 51.

A magnetic sensor 53 having a magnetic impedance element (MI element) is fixed on the connecting member 22c. The magnetic sensor 53 is fixed so that its magnetism sensing direction is aligned with the axis of the above-described orientation of the magnetic poles of the magnet 52 (see FIG. 3). A harness 55 for signal transmission is connected to the magnetic sensor 53.

The magnetic impedance element included in the magnetic sensor 53 is the same as the magnetism sensing element disclosed in Japanese Patent Laid-Open No. 2002-195854 or 2004-264050. This magnetic impedance element is a magnetic element using a magnetic phenomenon in which an impedance produced by applying a current changing with time to a magnetic wire such as an amorphous alloy wire is changed by an external magnetic field. With this magnetic impedance element, a magnetic field (magnetic flux) generated by the magnet 52 is detected.

As shown in FIG. 5, the magnet 52 is placed so that the north pole is provided at the lower end, and so that the orientation of the magnetic pole coincides with the direction of bending of the magnetism generator supporting member 51 and the springs 24 (the direction indicated by arrow L in FIG. 5). The magnetism sensing direction of the magnetic sensor 53 (indicated by arrow Z in FIG. 5) also coincides with the direction of bending of the magnetism generator supporting member 51 and the springs 24. A load converter 56 is connected to the magnetic sensor 53. A voltage output from the magnetic sensor 53 is converted by the load converter 56 into a signal representing a load applied from an occupant to the vehicle seat 1.

A method of detecting a load applied from an occupant to the vehicle seat 1 with the vehicle seat load detection device 5 according to this illustrative aspect of the present invention will now be described.

When no occupant is sitting on the seat cushion 2, no bend is caused in the springs 24 and the predetermined distance is maintained between the magnet 52 and the magnetic sensor 53. At this time, the magnetic sensor 53 detects the magnetic field (magnetic flux) formed by the magnet 52 and generates the predetermined voltage corresponding to the magnetic field (see FIGS. 3 and 5). The yoke 51c with which the upper end of the magnet 52 is
blocked has the function of causing lines of magnetic force produced from the magnet 52 to pass through the yoke 51c to gather below the magnet 52 instead of extending upward, thus increasing the sensitivity of the magnetic sensor 53.

When a vehicle occupant sits on the seat cushion 2, the magnetism generator supporting member 51 is downwardly bent together with the plurality of springs 24 by an amount according to the load applied from the occupant. With the downward bending of the magnetism generator supporting member 51, the magnet 52 supported on the magnetism generator supporting member 51 is brought closer to the magnetic sensor 53 fixed on the connecting member 22c (see FIG. 6). The magnetic field of the magnet 52 detected with the magnetic sensor 53 is changed according to the change in the distance between the magnet 52 and the magnetic sensor 53. The level of voltage ew output by the magnetic sensor 53 is also changed thereby.

The relationship between the stroke S (the amount of bending) of the springs 24 and the magnetism generator supporting member 51, and the voltage ew is shown in the diagram of FIG. 7. By using this relationship, the amount of bending of the magnetism generator supporting member 51 and the springs 24 can be detected from the voltage ew output by the magnetic sensor 53. When the amount of bending of the magnetism generator supporting member 51 and the springs 24 is found, the magnitude of the load applied to the plurality of springs 24 integral with the magnetism generator supporting member 51 can be detected on the basis of the spring characteristics of the springs 24.

As described above, the output voltage ew from the magnetic sensor 53 is converted by the load converter 56 into the signal representing the load applied from the occupant to the vehicle seat 1. That is, the vehicle seat load detection device 5 can detect the load applied to the vehicle seat 1 on the basis of the change of the magnetic field detected with the magnetic sensor 53.

In the vehicle seat load detection device 5 according to this illustrative aspect, when a vehicle occupants sits on the vehicle seat 1, the springs 24 are bent by the amount according to the load applied from the occupant to the vehicle seat 1. With the bending of the springs 24, the distance between the magnet 52 and the magnetic sensor 53 is changed. With the change in the distance between the magnet 52 and the magnetic sensor 53, the magnetic field of the magnet 52 detected with the magnetic sensor 53 is changed. The load applied to the vehicle seat 1 can be detected on the basis of the change of the magnetic field detected with the magnetic sensor 53.

The magnetic sensor 53 has high magnetic sensitivity and is, therefore, capable of detecting the displacement of the magnet 52 positioned at a distance of several ten millimeters therefrom. It is, therefore, possible to directly detect the load applied to the vehicle seat 1 from the amount of bending of the springs 24 without using any special displacement amount converting member or the like.

Thus, the vehicle seat load detection device 5 according to this illustrative aspect of the present invention can be designed by reducing the number of component parts in comparison with the conventional art and can be easily manufactured at a reduced cost.

The magnetic sensor 53 is attached to the connecting member 22c, i.e., the fixed member. Therefore, the magnetic sensor 53 to which the harness 55 is connected is not moved by seating, thus ensuring an improvement in durability of the electrical connection between the magnetic sensor 53 and the harness 55. Also, the facility with which furnishing with the harness 55 connected to the magnetic sensor 53 is performed is improved and the facility with which the magnetic sensor 53 is attached to the vehicle seat 1 is also improved.

When a vehicle occupant or the like sits on the vehicle seat 1, the magnetism generator supporting member 51 is downwardly bent together with the plurality of springs 24 to bring the magnet 52 closer to the magnetic sensor 53. Since at this time the distance between the magnet 52 and the magnetic sensor 53 is changed with the bending of the plurality of springs 24, the load applied to the vehicle seat 1 can be detected with the magnetic sensor 53 with high accuracy.

A modification of the Device in the Illustrative Aspect

An example of modification of the device in the illustrative aspect 1 of the present invention will be described with reference to FIGS. 8 and 9.

As shown in FIG. 8, the magnetism sensing direction of the magnetic sensor 53 may be set perpendicular to the direction of bending of the magnetism generator supporting member 51 and the springs 24.

As shown in FIG. 9, the orientation of the magnetic poles of the magnet 52 may be set perpendicular to the direction of bending of the magnetism generator supporting member 51 and the springs 24.

Other Illustrative Aspects

The present invention is not limited to the illustrative aspect described above with reference to the drawings. Technical scope of the present invention also includes, for example, illustrative aspects such as shown below. Further, various changes other than those described below may be made and implemented without departing from the gist of the invention.

1. The magnetism generator may be attached to the fixed member of the vehicle seat, while the magnetic sensor is attached to the springs.

2. An electromagnet may be used as a magnetism generator instead of the permanent magnet. The magnetic may be selected regardless of the existence/nonexistence of the yoke.

3. A magnetism generator and a magnetic sensor may be attached to the frame and spring members of the seat back and to detect a load applied from the back of an occupant to the seat back. Also, the load detection device may be attached to each of the seat cushion and the seat back to perform load detection with higher accuracy.

4. The south pole of the magnet may be placed on the magnetic impedance element side.

5. A plurality of magnetism generators and a plurality of magnetic sensors may be attached to perform load detection with higher further improved accuracy.

6. The magnetism generator and the magnetic sensor may be arranged so that the magnetism generator and the magnetic sensor are close to each other when no occupant is sitting on the seat, and are moved away from each other by bending of the seat cushion springs when an occupant sits on the seat.

7. The magnetism generator may be directly attached to the spring(s) without using the magnetism generator supporting member.
What is claimed is:

1. A vehicle seat load detection device for detecting a load applied to a vehicle seat having a non-bendable fixed member irrespective of the existence/nonexistence of the load and a flexible member displaceable relative to the fixed member by being bent under the applied load, through the amount of bending of the flexible member, the vehicle seat load detection device comprising:

   a magnetism generator which generates a magnetic field provided on one side of the fixed member and the flexible member, and a magnetic sensor having a magnetic impedance element provided on the other side to detect the magnetic field generated by the magnetism generator,

   wherein the flexible member is bent by an amount corresponding to the load applied to the vehicle seat to change the distance between the magnetism generator and the magnetic sensor and to thereby change the magnetic field generated by the magnetism generator, and the load applied to the vehicle seat is detected on the basis of the detected change of the magnetic field.

2. The vehicle seat load detection device according to claim 1, wherein the magnetic sensor is attached to the fixed member.

3. The vehicle seat load detection device according to claim 2, wherein the vehicle seat has a seat cushion to be sat on by an occupant; the flexible member comprises a plurality of spring members downwardly bendable by sitting on the seat cushion; the fixed member comprises a sheet frame for fixing the end portion of the spring members; a supporting member for supporting the magnetism generator is provided on the plurality of the spring members; a connecting member is stretched below the supporting member between two side portions of the seat frame facing each other so as to be opposed to the supporting member through a predetermined distance; the magnetic sensor is fixed on the connecting member; and the supporting member is downwardly bent together with the plurality of the spring members by seating on the vehicle seat to bring the magnetism generator closer to the magnetic sensor.

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