ACCELERATION SENSOR AND ELECTRICAL TERMINAL USED THEREFOR

The present invention relates to an acceleration sensor comprising a sensor body which is made of a piezoelectric element and placed in an insulating housing, and an electrical terminal which is connected to the sensor body to detect piezoelectricity of the sensor body.

The acceleration sensor of this kind is constructed in such a manner that a strip of the sensor body supported in the insulating housing deflects when acceleration is applied, and by detecting the piezoelectricity generated in the sensor body at that moment, the acceleration applied to the sensor body can be measured, and usually, the sensor body is connected to a circuit constituted for detecting the piezoelectricity via a pair of electrical terminals with one electrical terminal being connected to one side of a plate surface of the sensor body and the other electrical terminal to the other side of the plate surface of the sensor body.

In supporting the sensor body in the insulating housing and also of connecting a pair of electrical terminals to the sensor body, a method has been known previously in which a pair of electrical terminals are fixed in the insulating housing facing each other by a space of the thickness of the sensor body, and by sandwiching the sensor body between the pair of electrical terminals facing each other, support of the sensor body and connection of the sensor body to the pair of electrical terminals are achieved simultaneously.

However, since the conventional electrical terminals are considerably rigid and are not designed to be flexible, when the distance between the electrical terminals, namely, the space for supporting the sensor body is not set accurately, the supporting space tends

to be too wide for satisfactory electrical contact between the sensor body and the electrical terminals and also for support of the sensor body, or the space tends to be too narrow and the sensor body may be damaged when it is inserted between the terminals. Consequently, when the supporting space is too wide, reinforcement of the connection by conductive adhesives, etc., is required and when the supporting space is too narrow, reworking of fixing the electrical terminals and other additional work become necessary, thereby causing yield drop and higher production cost.

In the acceleration sensor of conventional construction, the dimension of the two electrical terminals to be secured for insertion of the sensor is affected by five precisions in total, that is, machining precision of the mounting reference plane of the insulating housing for mounting the electrical terminals machining precision of the insulating housing, respective machining precision of the two electrical terminals, and respective mounting precision of the two electrical terminals to the insulating housing.

The present invention has been achieved in light of the foregoing situation, and its objective is to present an acceleration sensor, which is not easily affected by the machining precision of the electrical terminals and easily provides a good connection between the electrical terminals and the sensor body and also a reliable support of the sensor body by the electrical terminals.

In order to achieve the aforesaid objective, in the acceleration sensor comprising an insulating housing, a strip of sensor body which is placed in the insulating housing, a first electrical terminal which has a contact section to engage with one plate surface of the sensor body and is fixed to the insulating housing, and a second electrical terminal which has a contact section to engage another plate surface of the sensor body and is fixed to the insulating housing wherein the first and

second electrical terminals are arranged in such a manner that the respective contact sections are mutually shifted in a longitudinal direction of the sensor body, such that a first abutting member, which engages with the other side of the plate surface of the sensor body at a position opposite to the contact section of the first electric terminal, is integrally formed with the insulating housing.

A second abutting member, which engages with the one side of the plate surface of the sensor body at a position opposite to the contact section of the second electrical terminal, is integrally formed with the insulating housing, and the sensor body is sandwiched between the contact section of the first electrical terminal and the first abutting member, and also between the contact section of the second electrical terminal and the second abutting member.

Also, the acceleration sensor of the present invention comprises an insulating housing, a strip of sensor body which is placed in the insulating housing, and electrical terminals which have contact sections to engage with plate surfaces of the sensor body and are fixed to the insulating housing, wherein the contact sections of the electrical terminals are formed in such a manner that they can be easily resiliently displaced in a direction approximately perpendicular to the plate surfaces of the sensor body.

Further, the acceleration sensor of the present invention comprises a strip of sensor body placed in an insulating housing, an electrical terminal is fixed to the insulating housing so as to engage with a plate surface of the sensor body and includes a U-shaped member fixed to a wall of the insulating housing and extends parallel to the sensor body from a bottom side of the insulating housing and a resilient contact member extends from the lower side of the U-shaped member

upwardly and engages with a plate surface of the sensor body.

According to the acceleration sensor of the present invention, since the two electrical terminals are arranged shifted in a longitudinal direction of the sensor body, and the space for inserting the sensor body is formed between the contact sections of the electrical terminals and the abutting member which is formed integral with the insulating housing, and the sensor body is sandwiched in this space, the dimensional error of the space is affected by only three precisions, namely, the machining precision of the surface of the abutting member, which engages with the sensor body (machining precision of the insulating housing), the machining precision of the electrical terminal facing the abutting member, and mounting presion of electrical terminal to the insulation housing. Therefore, compared with the conventional acceleration sensor, it is possible to set the dimension of the space more accurately, and with this, it is now possible to drastically reduce the incidence of damage of the sensor body at the time of inserting the sensor body in the space, contact failure between the sensor body and the electrical terminals, or support failure of the sensor body.

Furthermore, according to the present invention, by the arrangement of the two electrical terminals shifted in the longitudinal direction of the sensor body, it is possible to solve the technical problems such as the following.

Namely, in the conventional acceleration sensor in which the two electrical terminals are facing each other, when the two electrical terminals are mounted on the circuit board by soldering, there has been a good chance of short circuiting by the molten solder because of the close distance between the electrical terminals. According to the acceleration sensor of the present

invention, by the arrangement of the two electrical terminals shifted in the longitudinal direction of the sensor body, the distance between the two electrical terminals is greater; therefore, it is possible to drastically reduce the possibility of short circuiting between the two electrical terminals by the molten solder at the time of the mounting.

Also, according to another acceleration sensor of the present invention, by constucting the contact parts of the electric terminals in such a manner that they can be resiliently displaced in the direction approximately perpendicular to the plate surface of the sensor body, even when a dimensional error occurs in the space for the sensor body by the machining precision of the electrical terminals, this error can be absorbed within the region of the elastic deformation of the contact sections, and therefore, a good connection between the electrical terminals and the sensor body and also support of the sensor body by the electrical terminals is realized easily.

According to the electrical terminal of the present invention, since spring characteristic can be added effectively to the resident contact section, it is now possible to make a good electrical connection with the sensor body and support the sensor body securely by toleration errors caused by the machining precision, etc.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a plan view of the acceleration sensor according to one embodiment of the present invention.

Figure 2 is a cross-sectional view taken along line 2-2 of Figure 1.

Figure 3 is a cross-sectional view taken along line 3-3 of Figure 1.

Figure 4 is a plan view of the acceleration sensor according to another embodiment of the present invention.

Figure 5 is a cross-sectional view taken along line 5-5 of Figure 4.

Figure 6 is a cross-sectional view taken along line 6-6 of Figure 4.

As shown in Figure 1, acceleration sensor 10 comprises an insulating housing 11 in the shape of a rectangular frame, a strip of sensor body 12 is placed in the insulating housing 11 and extends in a longitudinal direction of the insulating housing 11, a first electrical terminal 13A which is connected to one side of a plate surface 12a of the sensor body 12, and a second electrical terminal 13B which is connected to the other side of the plate surface 12b of the sensor body 12.

As shown in Figure 2 and Figure 3, the first and second electrical terminals 13A, 13B are of identical shape, and comprise a U-shaped mounting section 13a and a resilient contact section 13b, which extends from the lower side of the mounting section 13a in a lateral direction and then upwardly. The first electrical terminal 13A and the second electrical terminal 13B are fixedly mounted to the insulating housing 11 by fitting the respective mounting sections 13a to side walls 11a and 11b from the bottom side thereof in the manner of a pinching action such that the first electrical terminal 13A is mounted to side wall 11a which extends in a longitudinal direction of the insulating housing 11, and the second electrical terminal 13B is mounted to side wall 11b of the insulation housing 11. Incidentally, on one side of the arm members 13c of the mounting sections 13a of the first and second electrical terminals 13A, 13B, projections 13d engage notches 11e located on the facing inside surfaces 11c, 11d of the side walls 11a, 11b.

As shown in Figure 1, the first and second electrical terminals 13A and 13B are arranged at positions mutually shifted in the longitudinal direction of the sensor body 12. At positions facing the resilient contact sections 13b of the first and second electrical terminals 13A, 13B, abutting members 14A and 14B are formed integral with the insulating housing 11.

At the inner ends of the abutting members 14A, 14B, contact surfaces 14a engage respectively with plate surfaces 12a, 12b of the sensor body 12, and the space between each contact surface 14a and contact section 13b of each electrical terminal is set slightly less than the thickness of the sensor body 12. The sensor body 12 is inserted in the insulation housing 11 from the bottom side into the space between the first and second electrical terminals 13A, 13B and the abutting members 14A, 14B, and thus it is fixed and supported in the insulating housing 11.

Because of such construction, the first and second electrical terminals 13A, 13B are shifted in the longitudinal direction of the sensor body 12, and they support the sensor body 12 with the contact surfaces 14a of the abutting members 14A, 14B, the dimensional error of the inserting space for the sensor body 12 is not readily caused; and furthermore, because of the structure of the first and second electrical terminals 13A, 13B of which the resident contact sections 13a have spring characteristics and are capable of elastic deformation in the direction perpendicular to the plate surfaces 12a, 12b of the sensor body 12, it is possible to make good electrical connection between the first and second electrical terminals 13A, 13B and the sensor body 12 without damaging the sensor body 12, and also to support the sensor body 12 securely therebetween.

The acceleration sensor 10, in which the sensor body 12 is inserted, is mounted by soldering on a circuit board which is not shown. Since the first and

second electrical terminals 13A, 13B are shifted, there is less possibility of short circuiting between the first and second electrical terminals 13A, 13B by the molten solder in this soldering process.

In the following, another embodiment of the acceleration sensor according to the present invention is explained. The acceleration sensor 20 of this shown in Figure 4 is of the same construction as the aforedescribed embodiment except that the abutting members 24A, 24B of the insulating housing are spring members. The abutting members 24A, 24B include resilient arms 24a which extend, respectively, from the lower part of the side wall 11a, 11b of the insulating housing 11, and further extend upward, and the contact projections 24b, which protrude laterally from the central part of the resilient arms 24a, and at the ends of the contact projections 24b, contact surfaces 24c, which contact, respectively, with the plate surfaces 12a, 12b of the sensor body 12 are located.

The addition of the resilient arms to the abutting members in this manner has an advantage in that, even when the two electrical terminals exceed the limit of the physical properties of materials by extreme miniaturization and they cannot have spring characteristics, the sensor body can still be fixed without damaging it.

Incidentally, although, in the acceleration sensors 10, 20, the electrical terminals 13A, 13B have resilient contact sections 13b, electrical terminals, which do not have resilient contact sections, can be used too.

In the foregoing, embodiments of the present invention have been explained, but the acceleration sensor and the electrical terminal of the present invention are not limited by the specifics of the embodiments, and it is a matter of course that various modifications are possible.

1. An acceleration sensor, comprising:

an insulating housing having opposed side walls providing a space therebetween;

a sensor body having a first and a second plate surface disposed in said space;

a first electrical terminal having a first mounting section mounted on one of the opposed side walls and a first contact section in electrical engagement with the first plate surface of said sensor body;

a second electrical terminal having a second mounting section mounted on another of the opposed side walls and a second contact section in electrical engagement with the second plate surface of said sensor body;

the first and second electrical terminals being shifted in a longitudinal direction relative to the sensor body; and

abutting members on the opposed side walls opposite the first and second electrical terminals engaging the sensor body.

2. An acceleration sensor as claimed in claim 1, wherein the first and second mounting sections are U-shaped.

3. An acceleration sensor as claimed in claim 2, wherein said first and second mounting sections have projections disposed in notches in the opposed side walls.

4. An acceleration sensor as claimed in claim 1, wherein the first and second contact sections are resilient.

5. An acceleration sensor as claimed in claim 1, wherein the abutting members are integral with said insulating housing.

6. An acceleration sensor as claimed in claim 5, wherein the abutting members include resilient arms.

7. An acceleration sensor, comprising:

a rectangular-shaped insulating housing having opposed sides and opposed ends providing a sensor body receiving space therein;

electrical terminals mounted on respective opposed sides of said insulating housing and spaced longitudinally from one another and having contact sections;

abutting members on respective opposed sides of said insulating housing spaced opposite the respective electrical terminals; and

a sensor body having plate surfaces on each side disposed between said contacts sections and said abutting members.

8. An acceleration sensor as claimed in claim 7, wherein said electrical terminals have mounting sections mounting the electrical terminals into the opposing sides.

9. An acceleration sensor as claimed in claim 8, wherein said mounting sections are U-shaped and have projections disposed in notches in the opposed sides.

10. An acceleration sensor as claimed in claim 7, wherein the contact sections are resilient.

11. An acceleration sensor as claimed in claim 7, wherein said abutting members are integral with said opposed sides.

12. An acceleration sensor as claimed in claim 11, wherein the abutting members include resilient arms.