



INFRARED SENSOR, SENSOR MANUFACTURING PALLET
AND METHOD OF MANUFACTURING INFRARED SENSOR

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an infrared sensor used for noncontact temperature sensing, human body sensing or the like and, more particularly, to the structures of an infrared sensor and a pallet for manufacturing an infrared sensor and to a method of manufacturing the infrared sensor.

2. Description of the Related Art

An infrared sensor such as that schematically illustrated in Fig. 6 only with respect to the structure of a case is known. This infrared sensor 20 has a flat plate-like infrared filter 21, and a metallic case 23 which has an open window 22 formed so as to expose the infrared filter 21 to the outside and in which a sensor element (not shown) is provided.

This infrared filter 21 has an insulating layer (not shown) formed on each of its inner and outer surfaces. This infrared filter 21 is placed in a stepped portion 24 of the case 23 formed around the open window 22 and projecting outward, and is fixed by using an electroconductive adhesive 25.

Ordinarily, the infrared sensor 20 thus constructed is manufactured by a process described below. First, as shown in Fig. 7(a), a sensor manufacturing pallet 27 having a through hole 26 formed therein to hold the case 23 in a downward-facing state is prepared, and an electroconductive adhesive 25a having a thermosetting property is applied on an inner surface of the stepped portion 24 of the case 23 held



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by this sensor manufacturing pallet 27. This electroconductive adhesive 25a is applied for the purpose of preventing an electroconductive adhesive 25b successively applied for electric conduction from flowing out of the open window 22. Needless to say, there is no problem about using an insulating adhesive in place of electroconductive adhesive 25a.

Next, as shown in Fig. 7(b), the infrared filter 21 is placed in the stepped portion 24 of the case 23, followed by setting (hardening) electroconductive adhesive 25a. Thereafter, as shown in Fig. 7(c), electroconductive adhesive 25b having a thermosetting property is applied between the end surface of the infrared filter 21 and the inner surface of the case 23 and is set. As a result, the infrared filter 21 and the case 23 are electrically connected to each other by electroconductive adhesive 25b, and the infrared sensor 20 taken out of the through hole 26 of the sensor manufacturing pallet 27 has the essential-part structure shown in Fig. 6.

The conventional infrared sensor 20 and the manufacturing method described above, however, entail problems described below. That is, although the infrared filter 21 thereof has a high material cost, the infrared filter 21 has an unnecessarily large size. This is because it is designed so as to be supported by the stepped portion 24 formed around the open window 22 as long as the above-described conventional arrangement is adopted even if a shape and a size corresponding to the open window 22 of the case 23 may suffice. The material cost is thus increased.

The working cost of the case 23 is also increased since there is a need for forming the stepped portion 24 around the open window 22 in the case 23. When the infrared filter 21 is fixed in the case 23, it is necessary to separately apply and set electroconductive adhesives 25a and 25b for flow-out

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prevention and electric conduction, i.e., to perform adhesive application and setting two times, resulting in an increase in the number of process steps.

5 An idea of an infrared sensor 30 having an essential-
portion structure such as that shown in Fig. 8, designed to
avoid the above-described problem, has been conceived. That
is, this infrared sensor 30 has an infrared filter 31 and a
case 33 in which this infrared filter 31 is accommodated and
in which an open window 32 is formed. This infrared filter
10 31 has a stepped portion 34 formed in its end face and fixed
to a frame of the open window 32 by using an
electroconductive adhesive 35. However, if this arrangement
is adopted, the size of the infrared filter 31 itself is
increased with the formation of the stepped portion 34, also
15 resulting in an increase in material cost.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of
these problems, and an object of the present invention is to
20 provide an infrared sensor, a sensor manufacturing pallet and
an infrared sensor manufacturing method which enable
simplification of the structures of the infrared filter and
the case as well as simplification of the manufacturing
process.

25 An infrared sensor of the present invention comprises a
flat plate-like infrared ^{filter}~~sensor~~ and a case having an open
window formed therein to accommodate the infrared filter,
wherein an outer surface of the infrared filter accommodated
in the open window is placed so as to be flush with an outer
30 surface of the case while an end surface of the infrared
filter is fixed to a frame of the open window by using an
electroconductive adhesive.

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A sensor manufacturing pallet of the present invention is used when the above-described infrared sensor is manufactured, the sensor manufacturing pallet comprising a pallet bottom surface on which the outer surfaces of the infrared filter and the case are brought into abutment in a state of being flush with each other, and in which a groove is formed, the groove being in such a position as to correspond to end surfaces of the infrared filter and the open window opposed to each other, the groove having a width larger than the distance by which these end surfaces are spaced apart from each other. It is preferable that the groove is open to the outside air.

A method of manufacturing an infrared sensor in accordance with the present invention comprises a step of bringing the outer surface of the case into abutment on the pallet bottom surface of the sensor manufacturing pallet and placing the end surface of the open window above the groove, a step of accommodating the infrared filter so that the outer surface of the infrared filter abuts on the pallet bottom surface and so that the end surface of the infrared filter is also placed above the groove, a step of applying an electroconductive adhesive between the end surface of the infrared filter and the frame of the open window, and a step of setting the electroconductive adhesive by heating the same.

For the purpose of illustrating the invention, there is shown in the drawings several forms which are presently preferred, it being understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic sectional perspective view of only the structure of an essential portion of an infrared

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filter which represents an embodiment of the present invention.

Fig. 2 is an exploded sectional perspective view of a sensor manufacturing pallet.

5 Figs. 3(a) to 3(c) are perspective views of modified examples of a pallet bottom plate.

Figs. 4(a) and 4(b) are process-step sectional views of a process of manufacturing the infrared sensor relating to the embodiment of the invention.

10 Fig. 5 is a process-step sectional view of a manufacturing process in the case of using a sensor manufacturing pallet having a structure different from that of the embodiment.

Fig. 6 is a schematic sectional perspective view of only the structure of an essential portion of an infrared sensor according to the conventional art.

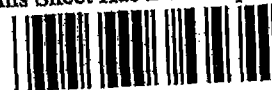
Figs. 7(a) to 7(c) are process-step sectional views of a process of manufacturing the infrared sensor according to the conventional art.

20 Fig. 8 is a sectional perspective view of another example of the infrared sensor according to the conventional art.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

25 An embodiment of the present invention will be described below with reference to the drawings.

Fig. 1 is a schematic sectional perspective view of only the structure of an essential portion of an infrared sensor which represents an embodiment of the present invention. A reference numeral 1 of this figure indicates the infrared sensor. Fig. 2 is an exploded sectional perspective view of an sensor manufacturing pallet relating to this embodiment, Figs. 3(a) to 3(c) are perspective views



of modified examples of a pallet bottom plate, Figs. 4(a) and 4(b) are process-step sectional views of a process of manufacturing the infrared sensor relating to this embodiment, and Fig. 5 is a process-step sectional view of a

5 manufacturing process in the case of using a sensor manufacturing pallet having a structure different from that of this embodiment.

The infrared sensor 1 which represents an embodiment of the present invention includes a flat plate-like infrared
10 filter 2 through which infrared rays can pass. The infrared sensor 1 further includes a case 4 which has an open window 3 rectangular in plan and capable of holding the infrared filter 2 set therein. A sensor element 6 formed on a base
15 palate 7 is provided in the case 4 so as to receive infrared rays through the infrared filter 2. An outer surface of the infrared filter 2 set in the open window 3 is flush with an outer surface of the case 4. An end surface of the infrared filter 2 is fixed to a frame of the open window 3 by using an
20 electroconductive adhesive 5. The infrared filter 2 and the case 4 are electrically connected to each other by the electroconductive adhesive 5 penetrating into a gap S1 between the opposed end surfaces of the infrared filter 2 and the open window 3 (see Fig. 4(a)) by the effect of its
25 surface tension. This infrared filter 2 has an insulating layer (not shown) formed on each of its inner and outer surfaces, as do the conventional infrared filters.

This infrared filter 2 has a simple flat plate-like shape corresponding in size to the open window 3 of the case 4 unlike the infrared filter 31 shown in Fig. 8, i.e.,
30 infrared filter 31 having a stepped portion 34 formed in its end surface. In this case, only open window 3 is formed in the case 4 and no stepped portion 24 such as that in the case 23 shown in Fig. 6 is formed. Thus, the infrared sensor



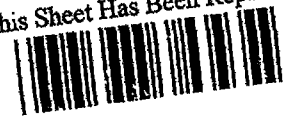
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1 in accordance with this embodiment has the structure of the infrared filter 2 and the case 4 simplified in comparison with the conventional infrared sensors.

5 A sensor manufacturing pallet 10 is used when the infrared sensor 1 is manufactured. The sensor manufacturing pallet 10 has a pair of upper and lower pallet plates 11 and 12 such as shown in Fig. 2. A through hole 13 having a shape suitable for accommodating the case 4 is formed in the upper pallet plate 11 while a groove 14 having a predetermined
10 depth and having a frame-like configuration is formed in a surface of the lower pallet plate 12 placed so as to close the lower opening of the through hole 13, i.e., in a pallet bottom surface. In this sensor manufacturing pallet 10, the outer surface of the case 4 in which the open window 3 is
15 formed and which is placed in the through whole 13 of the upper pallet plate 11 and the outer surface of the infrared filter 2 placed in the open window 3 are brought into abutment on the pallet bottom surface while being flush with each other.

20 The groove 14 formed in the pallet bottom surface is so positioned as to correspond to the opposed end surfaces of the infrared filter 2 and the open window 3. The groove 14 has a width larger than the gap S1 (Fig. 4(a)) by which these opposed end surfaces are spaced apart from each other.

25 Needless to say, it is not necessary that the recess 14 should have the above-described structure, i.e., a structure in which its upper opening is closed through its entire peripheral length with the infrared filter 2 and the case 4. Although the groove 14 shown in Fig. 2 is formed in the shape
30 of a closed loop, the groove 14 may be open to the outside air as shown in Fig. 3(a), 3(b) or 3(c), for example. That is, in the structures shown in Figs. 3(a) and 3(b), the groove 14 is extended from the four or two corners to be open

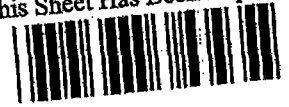


to the outside air between external end surfaces of the upper and lower pallet plates 11 and 12. In the structure shown in Fig. 3(c), a plurality of small-diameter through holes 15 formed through the lower pallet plate 12 in the direction of thickness thereof are open in the bottom surface of the groove 14. Through the through holes 15, the groove 14 communicates with the outside air.

The process of manufacturing the infrared sensor 1 in accordance with this embodiment will next be described with reference to Fig. 4.

First, as shown in Fig. 4(a), the sensor manufacturing pallet 10 formed by superposing the upper and lower pallet plates 11 and 12 is prepared, and the case 4 is accommodated in the sensor manufacturing pallet 10 by being inserted into the through hole 13 of the upper pallet plate 11 constituting the sensor manufacturing pallet 10. At this time, the outer surface of the case 4 is brought into abutment on the pallet bottom surface, i.e., the surface of the lower pallet plate 12 while the end surface of the open window 3 is placed above the groove 14. Subsequently, the infrared filter 2 is accommodated in the open window 3 of the case 4 with the outer surface of the infrared filter 2 brought into abutment on the pallet bottom surface and with the end surface of the infrared filter 2 placed above the groove 14.

Then, as shown in Fig. 4(b), electroconductive adhesive 5 is applied between the end surface of the infrared filter 2 and the frame of the window 3 by using a well-known dispenser (not shown) or the like, and is thereafter heated to set (main setting). The electroconductive adhesive 5 applied at this time penetrates into the gap S1 between the end surfaces of the infrared filter 2 and the open window 3 by the effect of its surface tension, and sets in the state of being maintained in the gap S1. As a result, the infrared filter 2



and the case 4 constituting the infrared sensor 1 are electrically connected to each other by electroconductive adhesive 5, and the infrared sensor 1 taken out of the sensor manufacturing pallet 10 has the essential-part structure
5 shown in Fig. 1.

If the sensor manufacturing pallet 10 has the structure shown in Fig. 2, it is in such a state that the upper opening of the groove 14 is closed with the infrared filter 2 and the case 4. In this case, therefore, as air existing in the
10 groove 14 is heated to expand, it is possible that the effect of fixation by electroconductive adhesive 5 becomes so low that the state of the infrared filter 2 and the case 4 being flush with each other becomes imperfect, resulting in occurrence of a tilt of the infrared filter 2. However, if
15 the sensor manufacturing pallet 10 having the lower pallet plates 12 formed as shown in Figs. 3(a) to 3(c) to have the groove 14 opened to the outside air is used, air can move freely into or out of the groove 14 and the air expanded in the groove 14 can escape to the outside air, so that the
20 infrared filter 2 and the case 4 can be maintained so as to be flush with each other satisfactorily completely.

According to the above-described process of manufacturing the infrared sensor 1, applying an electroconductive adhesive 5 and heat-setting the adhesive
25 only one time may suffice for obtaining the desired result, so that the number of process steps can be reduced. By an experiment made by the inventors of the present invention, it was confirmed that the bonding strength between the infrared filter 2 and the case 4 in the infrared sensor 1 manufactured
30 by the above-described manufacturing process was high enough for practical use, that is, it was 10.65 kgf on an average, which was not largely different from the average bonding strength of 10.3 kgf of the conventional infrared sensor 20.



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The embodiment has been described with respect to the case where the infrared sensor 1 having the structure shown in Fig. 1 is manufactured by using the sensor manufacturing pallet 10 shown in Fig. 2. However, the infrared sensor 1
5 can also be manufactured by using a sensor manufacturing pallet 17 such as that shown in Fig. 5, i.e., a sensor manufacturing pallet 17 having a structure different from that of the above-described embodiment. That is, in this sensor manufacturing pallet 17, a hole 18 closed at its
10 bottom is formed, in which the infrared filter 2 and the case 4 are accommodated in a downward-facing state, with the outer surfaces of the infrared filter 2 and the case 4 maintained so as to flush with each other. When the infrared sensor 1 is manufactured by using this sensor manufacturing pallet 17,
15 the infrared filter 2 and the case 4 are accommodated in the hole 18 having a closed bottom, and electroconductive adhesive 5 is applied and heat-set.

However, if this sensor manufacturing pallet 17 is employed, a gap S2 may exist between the outer surfaces of
20 the infrared filter 2 and the case 4 and the bottom surface of the hole 18 closed at the bottom, and it is possible that electroconductive adhesive 5 introduced into the gap s2 by the capillarity due to the existence of the gap can attach to the outer surface of the infrared filter 2. In contrast, if
25 the sensor manufacturing pallet 10 shown in Fig. 2 or 3 is employed, electroconductive adhesive 5 is maintained in the gap S1 between the opposed ends of the infrared filter 2 and the open window 3 by the effect of surface tension since the groove 14 is formed in the lower pallet plate 12, thus
30 avoiding the above-described drawback.

As described above, in the infrared sensor of the present invention, it is not necessary to form a stepped portion in an end surface of the infrared filter, so that the

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size of the infrared filter can be minimized. Since there is no need for forming a stepped portion in the case, the structure of each of the infrared filter and the case can be simplified to achieve a reduction in material cost and a
5 reduction in working cost. Also, a step of applying and setting an electroconductive adhesive is removed to simplify the manufacturing process.

While preferred embodiments of the invention have been disclosed, various modes of carrying out the principles
10 disclosed herein are contemplated as being within the scope of the following claims. Therefore, it is understood that the scope of the invention is not to be limited except as otherwise set forth in the claims.

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What is claimed is:

1. An infrared sensor comprising a flat plate-like infrared ~~sensor~~^{filter} and a case having an open window formed therein to accommodate the infrared filter,

5 wherein an outer surface of the infrared filter accommodated in the open window is placed so as to be flush with an outer surface of the case while ~~an end~~^{side surfaces} surface of the infrared filter ~~is~~^{are} fixed to a frame of the open window with an electroconductive adhesive.

10 2. A sensor manufacturing pallet used when the infrared sensor according to Claim 1 is manufactured, said sensor manufacturing pallet comprising a pallet bottom surface on which the outer surfaces of the infrared filter and the case are brought into abutment in a state of being flush with each other, and in which a groove is formed, the groove being in such a position as to correspond to ~~end~~^{side} surfaces of the infrared filter and the open window opposed to each other, the groove having a width larger than the distance by which these ~~end~~^{side} surfaces are spaced apart from each other.

25 3. A sensor manufacturing pallet according to Claim 2, wherein the groove is open to the outside air.

30 4. A method of manufacturing an infrared sensor comprising a step of bringing an outer surface of a case into abutment on a pallet bottom surface of a sensor manufacturing pallet and placing ~~an end~~^{side surfaces} surface of an open window above a groove, a step of accommodating an infrared filter so that an outer surface of the infrared filter abuts on the pallet bottom surface and so that ~~an end~~^{side surfaces} surface of the infrared filter ~~is~~^{are} also placed above the groove, a step of applying an

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electroconductive adhesive between the ~~end surface~~^{side surfaces} of the
infrared filter and a frame of the open window, and a step of
setting the electroconductive adhesive by heating the same.

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