

WATERPROOF STRUCTURE OF CASES

BACKGROUND OF THE INVENTION

The present invention relates to a waterproof structure of cases, and more particularly to a waterproof structure of cases for use outdoors which employs two types of sealing materials.

It should be understood that there are cases in this specification where one case and the other case which interfits thereto are generally called as a case.

Conventionally, portable apparatus and outdoor arrangements are configured, for example, to have a structure to allow cases thereof to interfit with each other through packing in order to achieve waterproof. Figs. 1A - 1C show one example of a conventional waterproof structure of cases which utilize packing. The structure which allows a case 21 and a case 22 to interfit with each other provides waterproof by inserting packing 24 into a groove 23 disposed in a sealing portion of the case 21 and fitting the case 22 thereto. The packing 24 consists of a packing body 24A and a packing fin 24B, wherein when the packing 24 is inserted into the groove 23, the fin 24B presses walls of the groove 23 due to the elasticity and the packing body 24A is also subjected to a pressure from a side wall of the groove 23, which resists coming off of the packing 24.

However, there is a possibility that the packing 24 comes off when the case 22 is closed or opened, and if the packing is remains in the state of improperly inserted, then the waterproof is no longer assured. The above-mentioned waterproof structure is provided with schemes to press fit the packing 24 into the groove 23, but it is not necessarily said that the packing is never off the groove 23.

As a waterproof structure of cases which solves the above-mentioned problem, there is proposed a waterproof structure obtained by utilizing a sealing method by disposing a groove in a sealing portion of a case and applying silicon, silicone rubber, silicone resin or the like into the groove. Figs. 2A and 2B show one example of a waterproof structure of cases obtained through this sealing method. This waterproof structure which allows a case 31 and a case 32 to interfit with each other achieves waterproof by forming a sealing element 34 by directly applying silicon into a groove 33 which is disposed in a sealing portion of the case 31 and then interfitting the cases 31 and 32. As the silicon is directly applied to the case 31, the resultant adherence makes the silicon resistant to falling off.

Figs. 3A to 3C show a waterproof structure for semiconductor devices described in Japanese Unexamined Patent Publication (JP-A) No. 17359 of 1992. A radiator 45 has a water channel 45 for cooling to dissipate heat of a semiconductor within a cover 43 by conduction cooling

through a metallic base plate 44. On the other hand, a frame-like packing 41 which is disposed around the perimeter of a cover 43 presses the cover 43 due to the elasticity through a protrusion 42 thereof and prevents a water drop 4a on the radiator 45 from entering into the cover 43. The cover 43 is joined to the metallic base 44 with adhesive 46. However, this waterproof structure has a low possibility for application to portable apparatus and outdoor arrangements because of problems associated with durability and appearance.

In the conventional sealing method as shown in Figs. 2A and 2B, a gap is formed at the sealing portion due to the resilience of silicon when the cases are interfitted. Especially, when this sealing method is applied to plastic cases, the possibility of deformation of the cases arises. The reason of this is there is no area for relieving a resultant volume of the squeezed silicon when the cases are interfitted.

If the silicon with a low degree of hardness (or any material with a compressibility) is used for overcoming the disadvantages as mentioned above, the resilience is resolved because of its compressibility, however, waterproof decreases compared with the silicon having a higher hardness. The reason is that the compressibility of the silicon with a lower hardness is less than the silicon having a higher hardness, and therefore the former has a lower waterproof property than the latter.

SUMMARY OF THE INVENTION

An object of the present invention is, when a pair of cases are interfitted, to avoid formation of a gap at a sealing portion of a case and occurrence of a deformation of the cases by providing an area for relieving a resultant volume of a squeezed sealing element.

In accordance with the present invention, there is provided a water proof structure of cases, wherein, at a sealing portion of one of a pair of cases to be interfitted, a sealing element is formed from a first material having a lower hardness and a compressibility which is directly applied to the case and a second material having a higher hardness and an elasticity which is directly applied to the first material, and wherein the sealing element is squeezed by another case for achieving waterproof.

The waterproof structure in accordance with the present invention provides a waterproof property by interfitting the cases by tightening screws and pressing the elastically deformable sealing element at the sealing portion. The sealing element is formed by directly applying a material such as silicon or the like having a lower hardness and a compressibility to the case and then directly applying thereon another material such as silicon, silicone rubber, silicone resin or the like having a higher hardness and an elasticity. The less hard silicon or the like is compressed when some pressure is applied to the sealing portion, and therefore the resultant volume of the squeezed sealing material can be relieved thereto, which

avoids formation of a gap between the cases and occurrence of a deformation of the cases.

The harder silicon or the like formed on the surface of the sealing portion has a large elasticity which is sufficient to achieve waterproof.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1A is an exploded perspective view of a case which uses conventional packing for a waterproof structure;

Fig. 1B is a sectional view of a packing portion of the case before interfitting which uses the conventional packing for the waterproof structure;

Fig. 1C is a sectional view of the conventional packing which is used for a waterproof structure of cases;

Fig. 2A is an exploded perspective view of cases to which a conventional sealing method for waterproofing is applied;

Fig. 2B is a sectional view taken on line B-B in Fig. 2A;

Fig. 3A is a plan view of a conventional waterproof structure for semiconductor devices;

Fig. 3B is a sectional view of the conventional waterproof structure for semiconductor devices;

Fig. 3C is an enlarged sectional view of the conventional waterproof structure for semiconductor devices for illustrating the state that a water drop is formed on a surface of a radiator;

Fig. 4A is an exploded perspective view of cases having an embodiment of a waterproof structure in accordance with the present invention;

Fig. 4B is a sectional view taken on line A-A in Fig. 4A;

Fig. 4C is a sectional view of sealing portions of cases having the embodiment of a waterproof structure for illustrating a state before interfitting; and

Fig. 4D is a sectional view of sealing portions of cases having the embodiment of a waterproof structure for illustrating a state after interfitting.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will be described hereinafter with reference to the accompanying drawings.

Referring to Figs. 4A to 4D, a sample case for the purpose for using outdoors consists of a case 1 and a case 2 both of which have a structure to be sealed by tightening screws 6. The case 1 has a sealing portion in which a circular groove 3 is disposed all around, wherein silicon is applied into the groove 3 so as to be contained therein in order to form a elastically deformable sealing element 4 which is in contact with the groove 3. The sealing element 4 is formed from two materials which are different in hardness by applying silicon 7 with a lower hardness to an inner bottom surface of the groove 3 and further applying silicon 8 with a higher hardness thereto. Besides, a

protrusion 5 are disposed on and along a sealing portion all around of the case 2.

For the case configured as mentioned above, when the case 1 and case 2 are interfitted and the screws 6 are tightened, the protrusion 5 squeezes the sealing element 4, thereby waterproof can be achieved. At this time, the less hard silicon 7 has a compressibility for relieving a resultant volume of the squeezed silicon. Accordingly, no gap is formed between the case 1 and the case 2, and therefore the deformation of the cases can be avoided.

In addition, the harder silicon 8 allows for waterproof due to its high elasticity.

As is apparent from the descriptions as mentioned above, in accordance with the present invention, formation of a gap at a sealing portion and a deformation of cases can be avoided when interfitting the cases which are provided with a waterproof structure obtained by using a sealing method with an elastically deformable sealing element.

The reason is that the sealing element is formed by directly applying a material such as silicon or the like having a lower hardness and a compressibility to the case and further directly applying another material such as silicon or the like having a higher hardness and an elasticity thereto, and the less hard silicon is compressed when a pressure is applied to the sealing element, therefore a resultant volume of the squeezed sealing element can be relieved.

Further, in accordance with the present invention, the sealing element has a compressibility and an elasticity which allows for waterproof.

The reason is that the sealing element is formed by directly applying a material such as silicon or the like having a lower hardness and a compressibility to the case and further directly applying another material such as silicon or the like having a higher hardness and an elasticity thereto, and the harder silicon or the like has a high elasticity, therefore a resilience occurs when squeezed.



WHAT IS CLAIMED IS:

1. A water proof structure of cases, wherein, at a sealing portion of one of a pair of cases to be interfitted, a sealing element is formed from a first material having a lower hardness and a compressibility which is directly applied to said one of said cases and a second material having a higher hardness and an elasticity which is directly applied to said first material, and wherein said sealing element is squeezed by the other of said cases for achieving waterproof.

2. A waterproof structure of cases as claimed in claim 1, wherein both of said first and second materials are silicon.

3. A waterproof structure of cases as claimed in claim 1, wherein a projection disposed on said other case squeezes said sealing element.

4. A waterproof structure of cases as claimed in claim 1, wherein a circular groove is disposed in said one of said cases, and said sealing element is contained in said groove.