

SPECIFICATION

A compound plate assembly

The present invention relates to a compound plate assembly.

A compound plate assembly made of two different kinds of material is widely used, for example, in the electrical/mechanical field for insulating part of a metal chassis. In precision industries, such as the manufacture of watches and meters, a compound plate assembly is often used for partially enhancing frictional properties.

In the past, compound plate assemblies (which include irregular shaped plates having curvature and differences in thickness as well as planar plates) have been produced by cementing different kinds of materials or by connection with screws or the like. It is, however, difficult to produce such compound plate assemblies in this manner and also the mechanical accuracy of the products is poor.

Recently, there has been developed the so-called outsert moulding method of producing a compound plate assembly which is composed of a base plate made of metal or the like and a functional part such as a strip plate and a post fixedly connected thereto. In this method, the base plate has stop holes and is attached to a metal mould having cavities which produce functional parts to thereby integrally mould the compound plate assembly in a moulding process. Since a plurality of functional parts are formed on the same base plate in a single moulding operation, this method is widely used. (Refer to "PLASTIC", Vol. 26, No. 12, Pages 52 to 53). The outsert moulding method is applicable to compounding a synthetic resin plate and a plate formed of a hard material.

Few mechanical/electrical parts are composed of only planar plates. Most mechanical/electrical parts have holes such as a bearing hole and various functional portions thereon. According to the outsert moulding method such irregular portions can be integrally produced in the compounding operation of the plates. When the compounding of a synthetic resin plate is not especially required, if the metal moulding is complicated by fixing the adjacent functional parts with respective stop holes, it is available to outsert the functional parts together with the adjacent base plate portion.

A compound base plate produced by the outserting method is shown in Figs. 1 and 2 and includes a synthetic resin plate 2 formed with a functional hole 3 and fixedly secured to a hard plate 1 by holes 5, 5', 5'' and 5''' formed in the hard plate 1. In the inner portion of the dotted line shown at 4, the compound base plate is composed solely of synthetic resin material whereas in the outer portion thereof, the compound base plate is

composed of a laminate of the synthetic resin material and the material of the plate 1. In such a construction, shrinking forces are generated towards the center of the synthetic resin plate 2 due to moulding shrinkage thereof. However, since the outer peripheral portions of the synthetic resin plate 2 are supported at 5, 5', 5'' and 5''', the shrinkage is limited. Accordingly, in the case of a relatively hard base plate 1, marked distortions result in the synthetic resin plate 2, which causes damage therein in use. Also, in the case of a relatively soft base plate 1, the base plate 1 undergoes complex deformation.

Moreover, in a compound plate assembly it is necessary that there should be a high degree of accuracy in the relative positions of any functional part in the synthetic resin plate, such as the hole 3, and any other functional part on the hard base plate 1. If the synthetic resin plate 2 is not freely shrinkable, as is the case in the construction described in the preceding paragraph the position of the real center of the shrinkage is not stable and positioning accuracy between a particular point of the synthetic resin plate and a particular point on the hard base plate is seriously reduced.

Figs. 3 and 5 show a compound plate assembly including a synthetic resin plate 6 which is freely shrinkable. In this compound plate, the synthetic resin plate 6 is secured to a base plate 1 by one cutaway portion 7 formed in the base plate 1. Accordingly, damage, deformation and reduction in accuracy owing to a plurality of the stop holes are overcome. However, synthetic resin which is introduced into the cutaway portion 7 is solidified after the moulding shrinkage as shown by the dotted line 9 in Fig. 5. Accordingly, a gap is generated between the base plate and the synthetic resin plate so that the relative positioning therebetween is unstable and a marked deterioration in accuracy is again produced.

An object of the present invention is therefore to overcome or alleviate the above noted defects experienced in conventional compound plate assemblies.

Accordingly, the invention resides in a compound plate assembly including a hard material member having at least one cut-away portion extending between a pair of planar surfaces of the hard material member and a substantially planar, plate-like synthetic resin member produced by a moulding process, said members being integrally physically connected by at least partly filling said cut-away portion with said synthetic resin, a centre of shrinkage of said synthetic resin being defined at a predetermined position by arranging that the cut-away portion has a closed peripheral edge and includes at least one independent through-hole in contact with or in the vicinity of said closed peripheral edge.

In the accompanying drawings:

Figure 1 is a plan view of a prior art compound plate assembly,

Figure 2 is a cross section taken along the line A-A in Fig. 1;

Figure 3 is a plan view of a further prior art compound plate assembly,

Figure 4 is a cross section taken along the line B-B in Fig. 3;

Figure 5 is a cross section taken along the line C-C in Fig. 4;

Figure 6 is a plan view of a compound plate assembly according to one example of the present invention and

Figure 7 is a plan view of another form of synthetic resin plate of a compound plate assembly according to the present invention, wherein the dotted line designates the cut-away portion in the hard base plate of the assembly.

Referring to Fig. 6, the assembly of said one example according to the present invention has substantially the same function as the prior art devices shown in Figs. 1 to 5.

However, in the assembly of said one example a central cut-away portion of rectangular form is provided in the hard base plate. A sub-stop hole 14 formed as a through-hole in contact with the central cut-away portion is also provided in the base plate. The synthetic resin material is freely shrinkable during the moulding process to the center of shrinkage.

Therefore, the mechanical accuracy is high without distortions in the final product.

In the example shown in Fig. 7, the base plate has a small circular cut-away portion 16 which is formed as a through-hole in a region of the base plate projecting into a larger cut-away portion 15. In this example also, the synthetic resin is freely shrinkable to the center of shrinkage.

In the examples shown in Figs. 6 and 7, the centres of shrinkage are defined to a line or an acceptably small or narrow area of displacement.

The shrinkage direction control can, of course, also be attained by the combination of the above-described techniques.

The embodiments shown are represented by the combination mainly of straight lines. However, in order to obtain substantially the same effect as these embodiments, it is possible to employ combinations of curved lines. Especially, in view of the reduction of the damage due to forming notches, it is possible to employ a mainly curved construction.

The configurations of the embodiments shown are simplified in order to provide a better understanding of the invention, although in practice, the configuration may be more complicated. In addition, it is to be appreciated that the thickness, the variation of shrinkage, and the like are not limited to specific values. The degree of overlap between the hard base plate and the synthetic

resin plate is also not particularly limited, so that various modifications are possible. Thus the overall surfaces of the hard base plate and the synthetic resin plate may be overlapped by small stop hole portions. Alternatively, overlapped portion may exist. As a further alternative, the hard base plate and the synthetic resin plate may be considerably overlapped.

The material of the hard plate is not limited to metal. The hard plate can be made of a synthetic resin or the like which is predeterminedly formed into a suitable configuration. The specific plate of the invention can be overlapped with a hard plate which is made by overlapping a mica plate and a metal plate.

The cutaway portion is a hole as shown in the drawings but otherwise the cutaway portion can be made by cutting away the peripheral portion of the base plate or the like. It is unnecessary to entirely fill the cutaway portion with resin.

CLAIMS

1. A compound plate assembly including a hard material member having at least one cut-away portion extending between a pair of planar surfaces of the hard material member and a substantially planar, plate-like synthetic resin member produced by a moulding process, said members being integrally physically connected by at least partly filling said cut-away portion with said synthetic resin, a centre of shrinkage of said synthetic resin being defined at a predetermined position by arranging that the cut-away portion has a closed peripheral edge and includes at least one independent through-hole in contact with or in the vicinity of said closed peripheral edge.

2. A compound plate assembly as claimed in Claim 1, substantially as hereinbefore described with reference to, and as shown in, Figs. 6 or 7 of the accompanying drawings.

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