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(54) PLATE ASSEMBLIES HAVING A SYNTHETIC PLASTICS MATERIAL BONDED THEREON

(71) We, POLYPLASTICS CO. LTD., a Japanese Company, of 30, 2-chome, Azuchi-machi, Higashi-ku, Osaka-shi, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to plate assemblies comprising a substrate plate e.g. a metallic plate, having a synthetic plastics material bonded thereon through one or more apertures therein. Such plate assemblies find use in for example recorders, radio receivers and watches. It is essential for such uses that the plastics material, which may be in the form of a functional member, should be bonded integrally with the substrate plate in a highly accurate and stable relationship therewith.

Various substrate plate devices have been known in the art. Some have the construction wherein a functional member such as a substrate base is secured to a metallic substrate plate by caulking while others have a substrate which is as a whole integrally formed by a synthetic resin material.

In recent years, a so-called "outsert moulded article" has gained a wide application in which a synthetic resin functional member is secured integrally during moulding to a metallic substrate plate having proper locking holes therefor. In this type of device the relationship between the synthetic resin and the metal at the locking portion is opposite to that of conventional "insert-type" devices and which therefore is referred to an "outsert moulding". (For details of outsert moulding, see "Plastics", Vol. 26, No. 12, pages 52—53).

The present invention relates to a substrate plate device which can be obtained easily by outsert moulding and provides a substrate plate device of high dimensional accuracy particularly when associated with a large synthetic resin functional member.

Disadvantages of certain prior art arrangements will now be explained with reference to Figures 1 to 6 of the accompanying drawings.

In these drawings:

Figure 1 is a perspective view of a plate assembly comprising a substrate plate having a moulded functional member thereon;

Figures 2, 3 and 4 are plan views of different methods of attachment of functional member of Figure 1;

Figure 5 is a cross-sectional view showing the effect of shrinkage of the synthetic resin functional member when secured through a plurality of apertures; and

Figure 6 is a sectional plan view of another conventional plate assembly along the surface of the substrate plate thereof.

Figures 7 to 18 illustrate various embodiments of plate assemblies in accordance with the present invention, wherein

Figure 7 is a plan view of an example of a plate assembly according to the present invention;

Figure 8 is a plan view showing the state of shrinkage at the locking aperture portion in the present device;

Figures 9 to 16 are plan views showing the shapes of the various slit apertures of the present device, respectively;

Figure 17 is a rear view of an example of a plate assembly according to the present invention wherein the functional member is partially locked on the rear surface of the substrate plate;

Figure 18 is a rear view of an example according to the present invention wherein the functional member is locked on the entire rear surface of the substrate plate.

Figure 1 illustrates a perspective view of a typical plate assembly in which a functional member 2 of a synthetic resin is shown disposed and locked on a substrate plate 1.

In Figure 2 a conventional construction is shown in which locking is effected at and by

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means of a plurality of independent apertures 3, 4, 5 and 6. The dotted lines in these Figures (and also in the following Figures) indicate the outer periphery or boundary of the functional member secured on the substrate plate 1.

Such locking will generally be enhanced and strengthened by those parts of the synthetic resin member 2 that have been extruded through apertures in the substrate plate. In assemblies of this type the mould shrinkage of the synthetic resin will cause deformation of the substrate plate, as shown in Figure 5.

In Figure 5 the reference numeral 9 indicates a synthetic resin functional member, 10 is a substrate plate and 11 is a locking element formed after extrusion of the synthetic resin through apertures 3 to 6 of Figure 1.

To cope with this problem of deformation, deformation-free devices have been proposed as illustrated in Figure 3 which have a single circular aperture 7, or as illustrated in Figure 4, a cruciform aperture 8. While shrinkage of the synthetic resin in such constructions does not apply a deforming force to the substrate plate, another problem arises in that the substrate plate and the synthetic resin moulded element are not secured sufficiently tightly to each other after shrinkage of the synthetic resin occurs, resulting in instability and dimensional inaccuracy, as indicated in Figure 6 wherein the full line 12 indicates the shapes of the aperture in the substrate plate and of the synthetic resin before the shrinkage and the dotted line 13 indicates the dimension of the moulded element after shrinkage.

The present invention seeks to overcome such difficulties by providing the apertures in the substrate plate with a particular configuration whereby the moulded element extruded therethrough can tighten itself on the substrate base as its contracts.

The invention provides a plate assembly comprising a substrate plate having a member of synthetic plastics material bonded thereon through one or more bonding apertures in the said plate, characterised in that the said bonding aperture or apertures include at least one portion extending towards an edge of the said plate radially from the said bonding aperture or from the centre of a group of such apertures, the said portion(s) having an enlarged width at their outer end.

Figure 7 illustrates an example of the plate assembly in accordance with the present invention which has the same outward appearance as the one illustrated in Figure 1. In Figure 7, the reference numeral 14 designates an example of an aperture of the present invention and the dotted line indicates the outer circumference of the synthetic resin member.

In this type of assembly, the synthetic resin

member having the shape indicated by line 15 at the aperture portion will cause shrinkage substantially in like figures as indicated by the dotted line 16 in Figure 8, and will adhere to the substrate plate even after the shrinkage shown in Figure 8, thereby neither causing unsteadiness nor applying any force to the substrate plate which would result in consequent deformation.

For the present invention, the fan shape as illustrated in Figure 8 is most preferred. However if a small degree of unsteadiness is acceptable, or if a small degree of deformation is allowable or the anisotropic property of the resin is large, various shapes such as shown in Figure 9 to Figure 16 may be used within the scope and object of the present invention, which shapes are illustrative of numerous embodiments obtained by combining or modifying them as desired within the scope of the invention.

In most of these examples as shown in Figures 9 to 16, the corner of the hole has been shown sharp. However, it is preferable to provide the aperture having the corners in the form of a smooth curve in order to eliminate a notch effect.

In the present device, the locking element of the synthetic resin protruded through the aperture to the rear surface of the substrate plate for strengthening the lock may be either partial as indicated by the dotted line 17 in Figure 17, or be whole as indicated by the dotted line 18 in Figure 18.

To further minimize unsteadiness, a treatment such as bending, corrugation, tapering, surface treatment and so forth may be applied to the surface of the substrate plate. If desired, a part of the resin existing in the aperture may be removed.

The assembly of the invention may be connected to another assembly by a synthetic resin member of a relatively deformable material e.g. a runner, or be restricted to a specific section of a large-sized device.

The assembly of the invention can be used widely as a component of such products as watches, electronic appliances, toys, etc., and is especially suitable for a large-sized synthetic resin body and a precision component.

The synthetic resin material used may for example be a crystalline resin, particularly a polyacetal although other thermosetting resins may be used.

WHAT WE CLAIM IS:—

1. A plate assembly comprising a substrate plate having a member of synthetic plastics material bonded thereon through one or more bonding apertures in the said plate, characterised in that the said bonding aperture or apertures include at least one portion extending towards an edge of the said plate radially from the said bonding aperture or from the centre of a group of

means of a plurality of independent apertures 3, 4, 5 and 6. The dotted lines in these Figures (and also in the following Figures) indicate the outer periphery or boundary of the functional member secured on the substrate plate 1.

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such apertures, the said portion(s) having an enlarged width at their outer end.

2. A plate assembly as claimed in Claim 1, wherein the said substrate plate is a metallic plate.

3. A plate assembly as claimed in Claim 1, wherein the said synthetic resin member is of the same shape as the substrate base.

4. A plate assembly as claimed in any of Claims 1 to 3, wherein the said synthetic resin member protrudes through the said bonding aperture(s) onto the rear surface of the substrate plate to form a locking element on the said rear surface.

5. A plate assembly as claimed in any of Claims 1 to 4, wherein the said synthetic plastics material is polyacetal.

6. A plate assembly substantially as hereinbefore described with reference to Figures 7 to 18 of the accompanying drawings.

HYDE, HEIDE & O'DONNELL,
2 Serjeant's Inn,
London EC4Y 1LL.
Chartered Patent Agents,
Agents for the Applicants.

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