

PATENT SPECIFICATION (11)

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(54) COMPOSITE ARTICLES

(71) We, POLYPLASTICS CO. LTD., a Japanese Company, of 30, 2-chome, Azu-chimachi, 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 a method of forming a composite article of shaped metal and a moulded synthetic plastics material.

Such composite articles are used in a wide range of industries, including the manufacture of motor vehicles, electrical goods, precision and agricultural machines, toys, furniture and office goods. Hitherto they have been prepared from separate parts separately shaped, or by moulding plastics material onto metal parts, which for example may subsequently be shaped.

One example of a moulding operation is so-called 'outsert' moulding. According to this process composite articles are obtained by fitting the inside of a mould with a pre-formed metal component and injecting a synthetic plastics material into the mould whereby the resin becomes integrated with the metal by flowing into apertures provided on the metal component. Such a technique is used widely for manufacturing components for tape-recorders and watches (see "Plastics", vol. 26, No. 12, pages 52—53).

The insert or outsert shaping process is a very economical one but it is still not entirely satisfactory. For example separately carrying out the shaping of the metal component and moulding the plastics component thereto requires a plurality of machines and operations. Special precautions have also to be observed which result in a high proportion of rejects.

When a metal base plate is used as a component in the outsert method, while it is relatively easy to place and pile a number of flat base plates one on another and then to automatically feed them successively to a shaping machine, with metal plates having curves or bends therein a special conveyor or like means is required to handle them,

automated processing then becoming very difficult.

The present invention is based upon using a mould assembly of a conventional injection moulding apparatus which also acts as a shaping device for the metal component, simultaneously effecting injection and shaping of the synthetic resin which is added to form the composite article. As a result simplicity and accuracy of the production of the components are significantly improved and a reduction in the rejection rate is achieved.

The invention provides a method of forming a composite article of shaped metal and moulded synthetic plastics material, comprising disposing a metal blank in a closable injection mould adapted to receive a metal blank, the said mould being provided with means whereby the metal blank may be shaped and/or cut, introducing mouldable synthetic plastics material into the mould and simultaneously with the shaping and/or cutting of the metal blank by the said shaping and/or cutting means the mouldable plastics material in the mould is moulded onto the metal blank to form a shaped and moulded composite article.

In particular the mould parts, together with any cores or pins utilized in the shaping process, are moved during clamping and opening of the mould or during the time when injection and solidifying of the synthetic plastics material is being carried out.

The metal which is used for one component of the composite article produced according to the invention may be a sheet metal blank, e.g. cold roll steel plate or aluminium plate, and the synthetic resin plastics material used for the other component may be a thermoplastic resin e.g. polyacetal, or a thermosetting resin.

There is no particular criterion for the shaping process, which may be a deformation step e.g. bending or drawing, or a cutting operation e.g. perforation.

The metal blanks may be formed from a continuous feed stock fed to the moulding during the method of the invention. Thus

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a continuous metal feed stock may be used in the form for example of block, rod or plate.

The use of preformed blanks is acceptable however if the overall process is not thereby rendered too complicated.

In conventional shaping of parts having a cut-out deformation of the e.g. metal part occurs in the lateral direction due to the shaping pressure of resin, but deformation is avoided in the steps of the present invention. Furthermore using metal or other components having a preformed complicated shape there has been a limitation to the formation of cavities therein for the synthetic resin to be made composite therewith, but with the present invention, such limitations can be reduced since the metal component is shaped during the filling of the mould with the mouldable plastics material.

The use of conventional injection moulding apparatus for the method of the invention is dependent on limitations imposed by the movement of the mould parts, and the degree of shaping which may be achieved may be limited using conventional machines. The type of moulding apparatus should therefore be selected bearing in mind the degree of shaping and accuracy desired.

In the shaping of metal blanks in the method of the invention, since a considerable force is exerted on the metal part, it is desirable to clamp the metal part before effecting the shaping operation.

Various embodiments of the invention are hereinafter particularly described and illustrated in Figures 1 to 7 of the accompanying drawings.

Figure 1 illustrates the formation by outsert moulding wherein a metal blank is bent during clamping the mould. Figure 1(A) is a cross-sectional representation of the mould in the open position showing a metal blank in position and Figure 1(B) shows a perspective view of the formed composite article.

In the arrangement of the mould of Figure 1A, 1 and 2 are the mould parts having mould cavities 3 and 4 respectively. A metal blank 5 having an aperture 6 is disposed between the mould parts. The mould part 1 has side members 7 and 7¹ for exerting a bending action on the metal blank during mould closure.

When the mouldable synthetic resin introduced into the mould is moulded onto the metal plate, the metal blank is bent by the closing action of the mould, and a spigot 9 is moulded to the unbent surface 8 to provide a moulded article as shown in Figure 1B.

Figures 2A and 2C illustrate the production of a moulded article by the method of the invention which is provided by outsert moulded spigots joined by a runner ob-

tained by a shaping process which is a shallow-drawing. Figure 2A shows a cross-sectional view along the line I—I of Figure 2C, of an open mould in vertical section. In Figure 2A the mould parts 1 and 2 are provided with mould cavities 3, 3¹, 4, 4¹ respectively, the said cavities 3, 3¹ being joined by a surface 5 of level below the general level of the die part 1, and the said cavities being joined by a surface 8 standing proud of the die part 2. The interposed metal blank 6 has two perforations 7, 7¹ corresponding to the aforesaid cavities in the mould parts wherein spigots 10, 10¹ are outsert moulded thereon, joined by a shallow-drawn runner 11 (Figure 2C).

In another embodiment illustrated in Figures 2B and 2D, a core 8 is provided in one mould part 2 which corresponds to the position of a cavity in mould part 1. On closure and after moulding a composite product is obtained as shown in side section in Figure 2D, wherein an indentation 12 is provided underneath the moulded part 11. The said moulded part 11 may be a runner. If desired the core 8 may be movable (e.g. by the action of a screw thread as shown) and moved to provide the indentation 12 after the mould has been clamped. The deformation of the metal blank due to the shrinkage of the runner is reduced by such drawing.

Figure 3 shows an example of providing a sharp nail-like member 3 in one of the mould parts 2 which is movable longitudinally so that a perforation is made in the metal blank 4 during closure of the mould parts 1 and 2 (Figure 3A) to produce after moulding a composite part shown in perspective in Figure 3B and in section in Figure 3C.

Figure 4 illustrates the cutting out of a metal blank from a continuous moving metal strip 5 by the cutting action of moving side walls 3, 3¹ of mould part 1 during closure of the mould parts 1 and 2 (Figure 4A). During passage of the strip past the mould a blank is separated therefrom leaving an aperture in the strip as shown in Figure 4D. During moulding the blank is perforated by mould core portion 4 to produce a composite product shown in perspective in Figure 4B and in vertical section in Figure 4C.

If desired the said core portion may be movable as referred to in the description of Figure 2.

Figure 5 shows an example of providing a cut-out in the method of the present invention. In the arrangement of mould parts 1, 2 of Figure 5A the corresponding mould configurations 2, 3 provide a cutting action to the blank during mould closure providing an aperture 6 in the final product 5 (Figure 5B). At the same time a spigot 7 is outsert

moulded through a preformed aperture in the blank.

5 Figure 6 shows an example of insert shaping. In the arrangement of mould parts 1 and 2 of Figure 6A, cavities 4 and 5 are provided. During closure of the mould parts, the lip portion 6 of mould part 1 exerts a bending action on the edge 3 of the metal blank, and at the same time an edge portion is insert moulded to produce a composite article as shown in Figure 6B.

WHAT WE CLAIM IS:—

15 1. A method of forming a composite article of shaped metal and moulded synthetic plastics material, comprising disposing a metal blank in a closable injection mould adapted to receive a metal blank, the said mould being provided with means whereby
20 the metal blank may be shaped and/or cut, introducing mouldable synthetic plastics material into the mould and simultaneously

with the shaping and/or cutting of the metal blank by the said shaping and/or cutting means the mouldable plastics material in the mould is moulded onto the metal blank to form a shaped and moulded composite article. 25

2. A method according to Claim 1, wherein the said mould includes means for imparting shape to the metal blank by bending, drawing, and/or perforating the metal blank. 30

3. A method according to Claim 1 or Claim 2, substantially as hereinbefore described with particular reference to the accompanying drawings. 35

4. A composite article obtained by a method according to any of Claims 1 to 3.

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1. A method of forming a composite article of shaped metal and moulded synthetic plastics material, comprising disposing a metal blank in a closable injection mould adapted to receive a metal blank, the said mould being provided with means whereby the metal blank may be shaped and/or cut, introducing mouldable synthetic plastics material into the mould and simultaneously

with the shaping and/or cutting of the metal blank by the said shaping and/or cutting means the mouldable plastics material in the mould is moulded onto the metal blank to form a shaped and moulded composite article.

2. A method according to Claim 1, wherein the said mould includes means for imparting shape to the metal blank by bending, drawing, and/or perforating the metal blank.

3. A method according to Claim 1 or Claim 2, substantially as hereinbefore described with particular reference to the accompanying drawings.

4. A composite article obtained by a method according to any of Claims 1 to 3.

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