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GB 2232920 A GB 2100662 A GB 1305982 A
EP 0596597 A1 EP 0255314 A2 JP 620044413 A
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(58) Field of Search
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(54) Abstract Title
**Improved compression moulding technique**

(57) A blank, comprising a mat of non-woven fibre impregnated with a plastics material, is placed in an open compression mould provided with a cavity 8. The latter is defined by first and second surfaces 4 and 5. The mould is closed to apply pressure to the blank to cause it to deform and fill the cavity 8. During cooling, the blank begins to shrink relative to its molten state. In order to account for this gas pressure is applied between second surface 5 and the blank, prior to solidification of the plastics material by cooling, to force the plastics material through the fibres and into contact with surface 4.

Thus, the super plastic flow of the thermoplastic take up the effect of any differential shrinkage which would, otherwise, occur.

The mat plastics 10 comprises a matrix of glass fibres impregnated with a thermoplastic such as polypropylene.

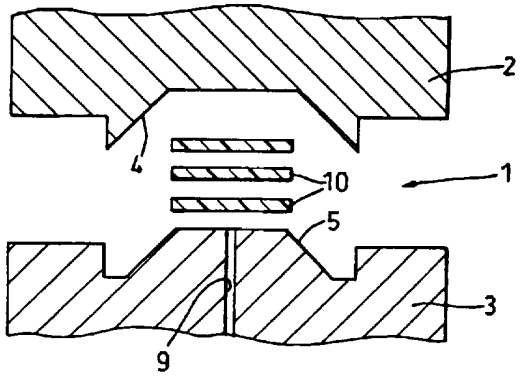


*Fig. 1*

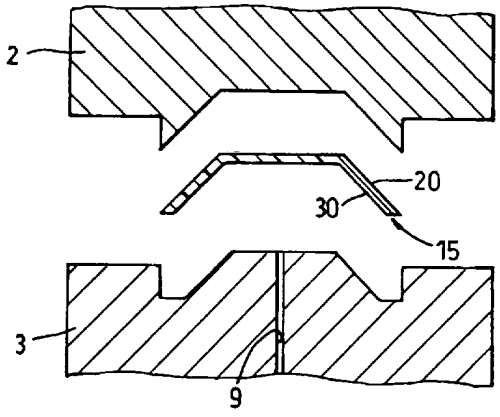


*Fig. 4*

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

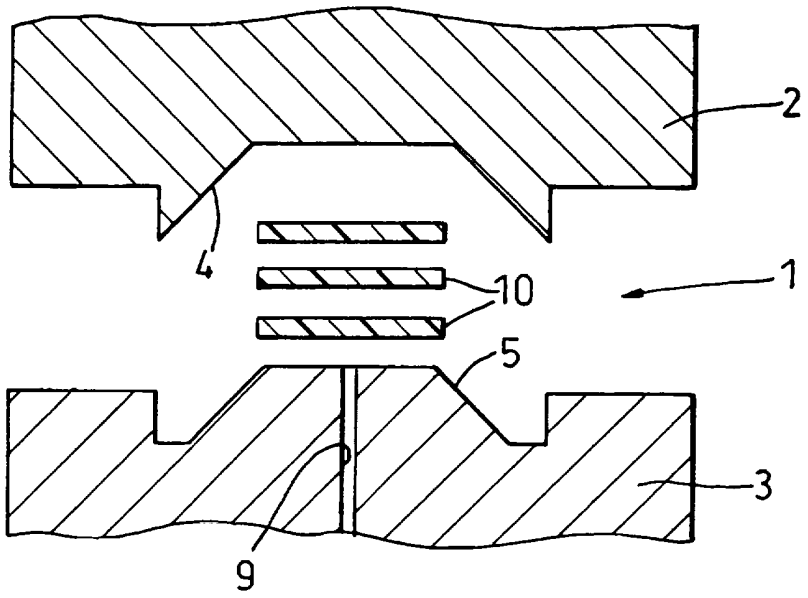


*Fig. 1*

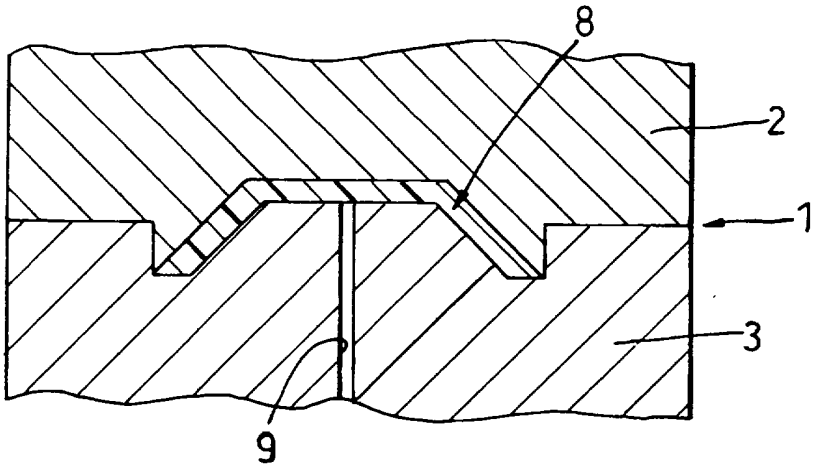


*Fig. 2*

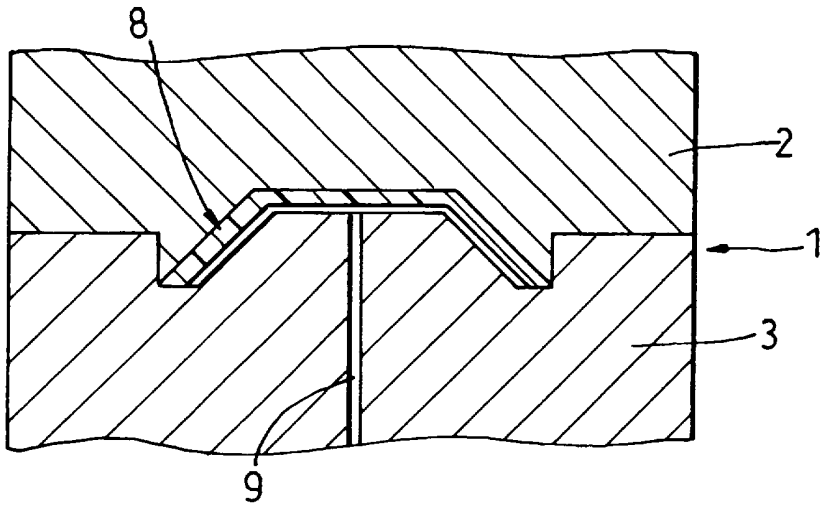


*Fig. 3*

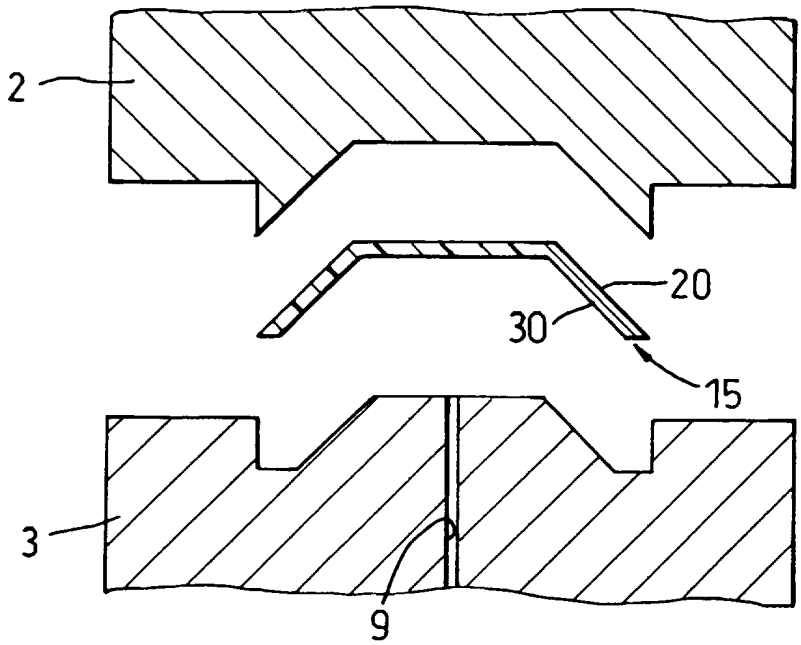


*Fig. 4*

# Improved Moulding Technique

The present invention relates to an improved compression moulding technique, in particular, but not exclusively, for use in the manufacture of components such as panels for automotive vehicles.

Fibre reinforced plastics components may conveniently be formed by compression moulding. In this process a blank is provided comprising a mat of non-woven fibre impregnated with a plastics material, the blank is placed in an open compression mould comprising a cavity defined by a first mould surface and a second mould surface, the mould is closed to apply pressure to the blank thereby causing the blank to deform and fill the cavity, the plastics material is allowed to solidify to a shaped moulding and the mould is opened to remove the moulding.

The surface finish of compression moulded fibre reinforced plastics components is generally quite poor. For instance, a glass mat impregnated with thermoplastic (GMT) such as polypropylene shrinks considerably relative to its molten state. The end result is that the glass fibres lie proud on the surface of the polypropylene creating an uneven and hence undesirable surface finish.

It is an advantage of the present invention that a superior surface finish can be obtained for a compression moulded fibre reinforced plastics material.

According to the present invention there is provided a method of forming a fibre reinforced plastics component including the steps of providing a blank comprising a mat of non-woven fibre impregnated with a plastics material, placing the blank in an open compression mould comprising a cavity defined by a first mould surface and a second mould surface, closing the mould to apply pressure to the blank thereby causing the blank to deform and fill the cavity, allowing the plastics material to solidify to a shaped moulding and opening the

mould to remove the moulding, wherein gas pressure is applied between the second mould surface and the blank prior to solidification of the plastics material to force the plastics material through the fibres and into contact with the first mould surface.

This method has the advantage that the surface finish of the component is determined by the surface finish of the second mould surface. In particular, a Class A automotive finish can be obtained by the use of a suitably smooth mould surface, for example a chromed mould surface.

The glass mat plastics blank may be heated prior to placing the blank in an open compression mould. Preheating expands the blank and places the plastics material in a condition that it might more easily flow to the shape desired. Conveniently, the blank comprises a plurality impregnated sheets of non-woven fibres.

The surface finish may be further improved by decreasing the quality of the surface finish of the first mould surface. This is because as the plastics material of the blank shrinks on cooling, a roughened surface enables the gas to pass behind the blank to apply more evenly a back pressure onto the blank to urge the blank into contact with the second mould surface of the mould cavity. Preferably, the first mould surface is peened.

Preferably, the second mould surface is below the first mould surface so that when the blank is placed in the mould it is placed on the second mould surface. This helps to improve the surface finish imparted by the first mould surface which is not cooled by the gas.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig.1 shows in diagrammatic form a section through an apparatus in one step in the method of the present invention;

Fig.2 shows in diagrammatic form a section through the apparatus of Fig.1 in a further step in the method of the present invention;

Fig.3 shows in diagrammatic form a section through the apparatus of Fig.1 in a still further step in the method of the present invention; and

Fig.4 shows in diagrammatic form a section through the apparatus of Fig.1 in a yet further step in the method of the present invention.

As shown in the drawings, a mould assembly 1 comprises a first, upper, mould half 2 and a second, lower, mould half 3. The upper mould half 2 includes a first mould surface 4 and the lower mould half 3 includes a second mould surface 5 complementary to the first mould surface 4. The first and second mould surfaces 4. 5, when brought together define a cavity 8. The lower mould half 3 also includes at least one passageway 9 through which a gas may pass into the mould cavity 8.

A stack of sheets 10 of a non-woven mat impregnated with a plastics material is placed onto the second mould surface 5 of the lower mould half 3 to form a blank. The fibre is typically glass and the thermoplastic material is typically a polypropylene. The sheets may be preheated prior to location in the mould. typically to about 200°C. Preheating expands the glass mat plastics sheets and places the plastics material in a condition to easily flow to the required shape.

The upper mould half 2 is then brought down into contact with the lower mould half 3 to form the cavity 8. The mould halves 2,3 close the cavity 8 about its edges to prevent the thermoplastics material from flowing out of the cavity. The

mould halves 2,3 are relatively cool, e.g. about 100°C. This allows the thermoplastics material to flow to fill the cavity prior to solidification on cooling.

During cooling, the blank begins to shrink relative to its molten state. In order to account for this, gas is introduced into the cavity 8 by way of the passageway 9. Typically compressed air may be used for this purpose. The thermoplastic is thus forced through the glass fibre mat and into contact with the first mould surface 4 as it shrinks during cooling. In other words, the superplastic flow of the thermoplastic takes up the effect of any differential shrinkage which would otherwise occur.

The mould assembly is then opened to allow for the removal of the moulded component 15. The finished component 15 has a surface finish on a front side 20 corresponding to the surface finish of the first mould surface 4. In this way, by using a chromed tool, a Class A automotive surface finish can be obtained on the front side 20 of the component 15.

The second mould surface 5 does not need to be of any particular surface quality if a rear surface 30 of the component is to be hidden from view. With this in mind, it is possible to provide grooves on the second mould surface 5 to encourage an even application of gas pressure on the cooling thermoplastic material. In the alternative, the second mould surface 5 may be peened to produce an uneven surface across the first mould surface. This will also encourage an even application of gas pressure on a rear surface of the cooling thermoplastic material ensuring that an improved surface finish is obtained on the front surface 20 of the component 15.

Preferably, the second mould surface is below the first mould surface so that when the blank is placed in the mould it is placed on the second mould surface.

This helps to improve the surface finish imparted by the first mould surface which is not cooled by the gas.

As an alternative, more even application of gas pressure at the rear surface of the cooling thermoplastic material may be obtained by providing further passageways through which the gas may pass into the mould cavity 8. Such further passageways are distributed about the first mould surface 8 to provide the gas pressure where required on the on the rear surface of the cooling thermoplastic material.

Instead of a thermoplastics material being used, a thermoset resin may be used in the blanks, in which case there may be less or no preheating of the blanks and the mould may be heated to effect the curing of the thermoplastic resin. In such a case the air pressure will be applied while the blank is still in a plastic state.

CLAIMS

1. A method of forming a fibre reinforced plastics component including the steps of providing a blank comprising a mat of non-woven fibre impregnated with a plastics material, placing the blank in an open compression mould comprising a cavity defined by a first mould surface and a second mould surface, closing the mould to apply pressure to the blank thereby causing the blank to deform and fill the cavity, allowing the plastics material to solidify to a shaped moulding and opening the mould to remove the moulding, wherein gas pressure is applied between the second mould surface and the blank prior to solidification of the plastics material to force the plastics material through the fibres and into contact with the first mould surface.

2. A method according to claim 1 wherein the blank is heated prior to placing the blank in an open compression mould.

3. A method according to claim 1 or claim 2 wherein the blank comprises a stack of said mats.

4. A method according to any preceding claim wherein the non-woven fibre is comprises glass.

5. A method according to any previous claim wherein the plastics material comprises a thermoplastic.

6. A method according to claim 5 wherein the thermoplastic comprises polypropylene.

7. A method according to any of claims 1 to 4, wherein the plastics material comprises a thermoset resin.

8. A method according to any previous claim, wherein the first mould surface is chromed.

9. A method according to any previous claim, wherein the second mould surface is peened.

10. A method according to any previous claim, wherein the second mould surface is below the first mould surface so that when the blank is placed in the mould it is placed on the second mould surface.

11. A method substantially as described herein with reference to Figs.1 to 4 of the accompanying drawings.

**Application No:** GB 9921778.8 **Examiner:** Monty Siddique
**Claims searched:** 1-11 **Date of search:** 31 January 2000

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B5A (AA1, AB11, AD20, AD28, AF35F, ANC, AT1P)

Int Cl (Ed.7): B29C 33/46 43/18 70/18 70/40

Other: Online: WPI EPODOC JAPIO; IPC-Edn 5 B29C 67/14

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | GB 2232920 A | (CARTER) page 3 lines 7/8, hot pressing, page 3 lines 17/18, gas-feeding-passage 7 | |
| X | GB 2100662 A | (NAVA) page 2 lines 59-65, page 3 lines 92-102 etc., page 4 lines 7-22 | 1 at least |
| Y | GB 1305982 | (UNION CARBIDE) page 4 lines 35-41, 101-122, page 6 lines 18-94 | 1 at least |
| Y | EP 0596597 A1 | (KASAI..) Column 9 lines 3-53 and particularly column 9 lines 37-48 | 1 at least |
| Y | EP 0255314 A2 | (THE WIGGINS) page 7 lines 38-45 | 1 at least |
| Y | US 5759476 | (ENGEL) column 2 lines 57-60, column 3 lines 3-8 | 1 at least |
| Y | JP 620044413 A | (UBE NITTO) see abstract | 1 at least |

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
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E Patent document published on or after, but with priority date earlier than, the filing date of this application.