

APPARATUS and METHOD for MOULDING ARTICLES USING GLASS

Field of the Invention

This invention relates to apparatus and method for the moulding of articles using glass and refers particularly, though not exclusively, to such apparatus and method for moulding articles requiring a relatively smooth surface.

Background to the Invention

When moulding articles requiring a relatively smooth surface the mould surface must be correspondingly smooth. Examples of such articles include, but are not limited to, optical lenses including lenses for digital cameras such as digital cameras incorporated into mobile telephones, personal digital assistants, computers, web cameras, and the like; and lenses uses in laser devices, measurement equipment, projectors, projector television receivers, sensor lenses, spectacle lenses, contact lenses, telescope lenses, microscope lenses, and lenses uses in medical devices.

Common techniques for preparing the surface of the mould, or mould insert, include fine machining, plating with zinc, then polishing. This is slow, time consuming, expensive, and unreliable. Furthermore, the zinc coating has a tendency to lift off with use, resulting in the mould or insert having to be resurfaced.

Summary of the Invention

In accordance with a first preferred aspect there is provided apparatus for moulding an article, the apparatus comprising:

- (a) a body having a recess;
- (b) a moulding cavity for insertion into the recess, the moulding cavity having a size and shape for the moulding of the article; and wherein
- (c) the moulding cavity is of a high temperature glass.

In accordance with a second preferred aspect there is provided a method for moulding an article comprising:

- (a) forming a recess in a body;
- (b) moulding a cavity of high temperature glass for insertion into the recess;
- (c) surface finishing an inner surface of the cavity; and
- (d) moulding the article in the cavity.

The high temperature glass may be a borosilicate glass, and the article may be an optical lens including a lens for digital cameras such as digital cameras incorporated into mobile telephones, personal digital assistants, computers, web cameras, and the like; and lenses uses in laser devices, measurement equipment, projectors, projector television receivers, sensor lenses, spectacle lenses, contact lenses, telescope lenses, microscope lenses, and lenses uses in medical devices.

The cavity may be formed in the recess or may be formed outside the recess and is inserted into the recess. The cavity may have a cavity wall with an outer surface, the outer surface being a neat fit in and being supported by the recess.

There may be reinforcing within the cavity wall for providing increased structural strength to the cavity. The reinforcing may have extensions passing through and extending beyond the cavity wall for providing heat conductivity from the cavity wall to the body adjacent the recess. The cavity wall may have a peripheral rim at an upper end thereof.

The apparatus may further comprise a cradle for supporting and holding the cavity. The cradle may be external of the cavity wall, follow the cavity wall and may be affixed to the cavity wall. Alternatively, the cradle may be moulded within the cavity wall. The cradle may comprise a plurality of bolt holes to enable the cradle to be releasably secured in the recess.

The cradle may comprise a plurality of equally spaced spokes extending from a lower hub to the rim of the cavity wall, and the cradle may be functionally connected to the extensions of the reinforcing.

Brief Description of the Drawings

In order for the invention to be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative drawings in which:

Figure 1 is a perspective view of a first embodiment;

Figure 2 is a vertical cross-section along the lines and in the direction of arrows 2 – 2 on Figure 1;

Figure 3 is a perspective view of a second embodiment;

Figure 4 is a vertical cross-sectional view along the lines and in the direction of arrows 4 – 4 on Figure 3;

Figure 5 is a perspective view of a third embodiment;

Figure 6 is a vertical cross-sectional view along the lines and in the direction of arrows 6 – 6 on Figure 5;

Detailed Description of the Preferred Embodiments

To first refer to Figure 1 there is shown a mould 10 that may in the alternative be a mould insert. The mould 10 has a body 12 and a mould cavity 14. The mould cavity is for the moulding of the article and has a size and shape required to form the article. The article may be an optical lens including lenses for digital cameras such as digital cameras incorporated into mobile telephones, personal digital assistants, computers, web cameras, and the like; and lenses uses in laser devices, measurement equipment, projectors, projector television receivers, sensor lenses, spectacle lenses, contact lenses, telescope lenses, microscope lenses, and lenses uses in medical devices.

The body 12 may include all necessary and required cooling channels and ducts (not shown). The body 12 may be made of any suitable material such as, for example, moulding steel, stainless steel, or the like.

The mould cavity 14 is of or is lined with a different material such as, for example, glass, high temperature glass or tempered glass. An example of a suitable glass is high temperature borosilicate glass as it can withstand temperatures of up to 450 degrees Celsius permanently, or up to 500 degrees Celsius for up to 10 hours. It has high impact resistance. The mould cavity 14 may be a separate component able to be inserted into and removed from the body 12, or may be moulded in situ in the corresponding concave recess 16 in body 12.

The recess 16 is preferably of the same size and shape as the outer surface 18 of cavity 14 so that the cavity 14 is a neat fit in and is fully supported within the recess 16. By having full support for the cavity 14 in the recess 16 and thermal or physical stresses generated in or applied to the cavity 14 will be transferred at least in part to the body 12 around recess 16.

By being of high temperature glass, the cavity has an inner surface 22 that is relatively smooth, and will be reliable as long as the temperature and physical stress levels of the glass used for cavity 14 are not exceeded. Even when of glass, the inner surface 22 may be polished to remove any surface imperfections.

Cavity 14 is held in recess 16 by any suitable means including a heat-conductive adhesive (not shown) and/or physical clamps (not shown) and/or by a captive nut within cavity wall 38 accessible by a bolt (not shown) passing through a bolt hole in body 12. To assist in the use of clamps, the cavity 14 may have a rim 26.

Figures 3 and 4 show a second embodiment. Here the cavity 14 has reinforcing 20. The reinforcing 20 may be a suitably sized and graded mesh (as shown), reinforcing rods, or the like. The reinforcing 20 is embedded within the cavity 14 during the moulding of cavity 14. Preferably, it is approximately midway between the outer surface 18 and the inner surface 22 of cavity 14. Alternatively, the reinforcing 20 may be closer to the inner surface 22 to assist in management and distribution of thermal and physical stresses on the cavity 14.

Preferably, the reinforcing 20 has a plurality of extensions 24 passing through and extending beyond the outer surface 18. The extensions 24 are integral with the reinforcing 20 and are to contact the inner surface of recess 16 when cavity 14 is inserted in recess 16 so as to enable transmission of heat to body 12 around recess 16. In this way the reinforcing 20 acts as a thermal conductor to assist in conducting heat away from cavity 14, and to thus assist in cooling cavity 14. The number, length and location of extensions 24 may be as required or desired. The reinforcing may be made of a metal, preferably a metal with good heat conductivity, and good physical strength. For example, the reinforcing 20 may be made of stainless steel. The glass of the cavity 14 may be transparent, translucent, cloudy or coloured, as required or desired. If transparent or translucent, the status of the reinforcing 20 will be able to be seen through the material of cavity 14, thus being of assistance for maintenance purposes.

Figures 5 and 6 show a third embodiment where a cradle 28 is added, in addition to or as an alternative to reinforcing 20. The cradle 28 may have a continuous side wall or, as shown, have a plurality of equally-spaced ribs 30 around the cavity 14.

The ribs 30 extend upwardly from a lower hub 32 and are affixed to the outer surface 18 of the cavity 14 preferably by use of a heat-conductive adhesive. The ribs 30 follow the shape of the outer surface 18. At the upper end 34 each rib 30 passes over the rim 26 and thus may be used to secure the cavity 14 in the recess 16. Each rib 30 may have one or more bolt holes 36 to enable a bolt (not shown) to pass through body 12 and into bolt hole 36 to secure the cradle, and thus cavity 14, in recess 16. The gaps 38 between ribs 30 may be used for a heat conductive adhesive to further enhance the securing of cradle 28 and cavity 14 in recess 16. The extensions 24 are in contact with or attached to cradle 28 to allow for heat conduction from reinforcing 20 to the cradle 28 and thus to body 12. To assist such heat conduction, the cradle is preferably made of a heat conducting material such as, for example, stainless steel.

As an alternative, the ribs 30 may be formed within cavity wall 38 with there being access to bolt holes 36 through cavity wall 38.

In this way the moulding process becomes somewhat simple. The body 12 is prepared and recess 16 formed. Cavity 14 is either separately moulded, or moulded in situ, with or without reinforcing 20 and/or cradle 28. If moulded separately, it is inserted and held in place as is described above. Any necessary surface finishing for inner surface 22 may be performed before insertion, or after insertion. The mould 10 is then ready for use. Moulding cycle times and temperatures may be selected to provide the best possible result without damaging the cavity 14. This may mean lower temperatures and slightly longer cycle times, but the result should be a significant improvement over the known processes. As glass inherently has a smooth finish, provided all surface irregularities are removed, the resultant moulded products should have the same or better characteristics as those moulded using known techniques.

Whilst there has been described in the forgoing description preferred embodiments of the present invention, it will be understood that many variations in details of design, construction or operation may be made without departing from the invention as defined in the following claims.

The Claims:

1. Apparatus for moulding an article by using glass, the apparatus comprising:
 - (a) a body having a recess;
 - (b) a moulding cavity for insertion into the recess, the moulding cavity having a size and shape for the moulding of the article; and wherein
 - (c) the moulding cavity is of a high temperature glass.
2. Apparatus as claimed in claim 1, wherein the high temperature glass is a borosilicate glass.
3. Apparatus as claimed in claim 1 or claim 2, wherein the article is an optical lens selected from the group consisting of: lenses for digital cameras including digital cameras incorporated into mobile telephones, personal digital assistants, computers, and web cameras; lenses uses in laser devices, measurement equipment, projectors, projector television receivers, sensor lenses, spectacle lenses, contact lenses, telescope lenses, microscope lenses, and lenses uses in medical devices.
4. Apparatus as claimed in any one of claims 1 to 3, wherein the cavity is formed in the recess.
5. Apparatus as claimed in any one of claims 1 to 3, wherein the cavity is formed outside the recess and is inserted into the recess.
6. Apparatus as claimed in any one of claims 1 to 5, wherein the cavity has a cavity wall with an outer surface, the outer surface being a neat fit in and being supported by the recess.
7. Apparatus as claimed in claim 6 further comprising reinforcing within the cavity wall for providing increased structural strength to the cavity.
8. Apparatus as claimed in claim 7, wherein the reinforcing has extensions passing through and extending beyond the cavity wall for providing heat conductivity from the cavity wall to the body adjacent the recess.
9. Apparatus as claimed in any one of claims 6 to 8, wherein the cavity wall has a peripheral rim at an upper end thereof.

10. Apparatus as claimed in any one of claims 6 to 9 further comprising a cradle for supporting and holding the cavity.
11. Apparatus as claimed in claim 10, wherein the cradle is external of the cavity wall, follows the cavity wall and is affixed to the cavity wall.
12. Apparatus as claimed in claim 10, wherein the cradle is moulded within the cavity wall.
13. Apparatus as claimed in any one of claims 10 to 12, wherein the cradle comprises a plurality of bolt holes to enable the cradle to be releasably secured in the recess.
14. Apparatus as claimed in any one of claims 10 to 13, wherein the cradle comprises a plurality of equally spaced spokes extending from a lower hub to the rim of the cavity wall.
15. Apparatus as claimed in any one of claims 10 to 14 when appended to claim 7, wherein the cradle is functionally connected to the extensions of the reinforcing.
16. A method for moulding an article by using glass, the method comprising:
 - (a) forming a recess in a body;
 - (b) moulding a cavity of high temperature glass for insertion into the recess;
 - (c) surface finishing an inner surface of the cavity; and
 - (d) moulding the article in the cavity.
17. A method as claimed in claim 16, wherein the high temperature glass is a borosilicate glass.
18. A method as claimed in claim 16 or claim 17, wherein the article is an optical lens selected from the group consisting of: lenses for digital cameras including digital cameras incorporated into mobile telephones, personal digital assistants, computers, and web cameras; lenses uses in laser devices, measurement equipment, projectors, projector television receivers, sensor lenses, spectacle lenses, contact lenses, telescope lenses, microscope lenses; and lenses uses in medical devices.
19. A method as claimed in any one of claims 16 to 18, wherein the cavity is formed in the recess.

20. A method as claimed in any one of claims 16 to 18, wherein the cavity is formed outside the recess and is inserted into the recess.
21. A method as claimed in any one of claims 16 to 20 further comprising inserting reinforcing within a cavity wall during the mould of the cavity for providing increased structural strength to the cavity.