APPARATUS AND METHOD FOR MULTI-CORE BI-INJECTION MOULDING

Field of the Invention

[1] The present invention relates to multi-material injection moulding, and in particular to a method and apparatus for performing multi-material injection moulding.

[2] The invention has been developed primarily for use in the production of plastics comprising multiple materials and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

Background of the Invention

[3] Presently, multi-material injection moulding systems comprise a platen system that is rotatable about an axis, necessitating the rotation of a large mass about a given axis. The present invention seeks to provide an apparatus and method that improves the efficiency and throughput of current multi-material injection moulding systems, which will overcome or substantially ameliorate at least some of the deficiencies of the prior art, or to at least provide an alternative.

[4] It is to be understood that, if any prior art information is referred to herein, such reference does not constitute an admission that the information forms part of the common general knowledge in the art, in Australia or any other country.

Summary of the Invention

[5] **According to a first aspect, the present invention may be said to consist in a mould positioning arrangement suitable for use in a multi-core injection moulding process, the mould positioning arrangement comprising:**

at least one supporting member configured for supporting at least one part-mould, the at least one part-mould being configured for moulding an item to be moulded in combination with a complementary part-mould; and

a moving arrangement configured for linearly moving the at least one part-mould between at least two positions.

[6] In one embodiment, the at least one-part mould is configured for moulding an item to be moulded in combination with the complementary part-mould.

[7] In one embodiment, the at least one part-mould is configured for moulding a plurality of items to be moulded in combination with the complementary part mould.

[8] In one embodiment, the mould positioning arrangement includes a plurality of mould parts.

[9] In one embodiment, the at least one supporting member is a mould base.

[10] In one embodiment, the mould base defines the mould.

[11] In one embodiment, the platen is configured for connection to the at least one part-mould.

[12] In one embodiment, the at least one part-mould defines a part-mould cavity.

[13] In one embodiment, the at least one part-mould defines a plurality of part mould cavities.

[14] In one embodiment, the at least one supporting member is configured for supporting a plurality of part-moulds.

[15] In one embodiment, the at least one part-mould is configured for engagement with a complementary part mould to define at least one mould cavity between the part-mould and the complementary part-mould.

[16] In one embodiment, the moving arrangement includes a hydraulic moving mechanism.

[17] In one embodiment, the hydraulic moving mechanism is a hydraulic ram.

[18] In one embodiment, the moving arrangement includes a gearing arrangement.

[19] In one embodiment, the gearing arrangement includes one or more selected from a worm gear, a helical gear, a cam arrangement and a rack and pinion arrangement.

[20] In one embodiment, the rotating threaded shaft is receivable into a complementary threaded member.

[21] In one embodiment, the at least one mould is configured for receiving a first injected material in a first position, and a second injected material in a second position.

[22] In one embodiment, the mould positioning arrangement includes an ejector plate.

[23] In one embodiment, the ejector plate includes ejector pins.

[24] **According to a further aspect, the present invention may be said to consist in a moulding device for moulding multicore items by injection moulding, the moulding device comprising:**

a material injection system; and

a mould positioning arrangement as described.

[25] **According to a further aspect, the present invention may be said to consist in a method of positioning at least one part-mould, the at least one part-mould including a plurality of mould cavities for moulding items to be moulded, the method of positioning at least one part-mould comprising the steps of:**

supporting the at least one part-mould on a supporting arrangement, the supporting arrangement being configured for moving the at least one part mould linearly between at least two positions; and

moving the part-mould linearly between a plurality of positions.

[26] **According to a further aspect, the present invention may be said to consist in a method of moulding items to be moulded in a multicore moulding process, the method comprising the steps of:**

supporting at least one part-mould on a supporting arrangement, the at least one part-mould including a plurality of mould cavities for moulding items to be moulded;

moving the part-mould linearly between a plurality of positions; and

injecting moulding material into the mould cavities in at least two of the plurality of positions.

[27] **According to a further aspect, the present invention may be said to consist in a method of moulding items to be moulded in a multicore moulding process, the method comprising the steps of:**

supporting at least one part-mould in a first position, the at least one part-mould including at least a first part-mould cavity and a second part-mould cavity;

engaging a complementary part-mould defining a first configuration with a periphery of the first part-mould cavity to present a first mould cavity;

injecting settable material into the first mould cavity to form a partially moulded item;

disengaging the complementary part-mould defining a first configuration from engagement with the at least one part-mould;

moving the at least one part-mould linearly to a second position;

engaging a complementary part-mould defining a second configuration with a periphery of the first part-mould cavity to present a second mould cavity; and

injecting settable material into the second mould cavity to form a moulded item.

[28] In one embodiment, the at least one part-mould is a single part-mould that defines a plurality of part-mould cavities.

[29] In one embodiment, the at least one part-mould comprises a plurality of part-moulds, together defining a plurality of part mould cavities.

[30] In one embodiment, the method includes the step of allowing the first material in the first mould cavity to set as the part-moulded item.

[31] In one embodiment, the method comprises the step of allowing the second settable material in the first mould cavity to set as a moulded item.

[32] In one embodiment, the method comprises the step of disengaging the complementary part-mould defining a second configuration from the at least one part-mould defining a first part-mould cavity.

[33] In one embodiment, the method comprises the step of ejecting the moulded item from one or more selected from the first part-mould cavity and the complementary part-mould defining a second configuration.

[34] In one embodiment, the method comprises the step of moving the at least one part-mould defining a first part-mould cavity back to the first position.

[35] In one embodiment, the step of moving the at least one part-mould defining a first part-mould cavity linearly to a second position includes the step of moving the at least one part-mould defining a second part-mould cavity to a first position.

[36] In one embodiment, the step of engaging a complementary part-mould defining a second configuration with a periphery of the first part-mould cavity to present a second mould cavity, includes the step of engaging a complementary part-mould defining a first configuration with the periphery of the second part-mould cavity, to present a first mould cavity.

[37] In one embodiment, the method includes the step of injecting settable material into the first mould cavity formed by the engagement of the complementary part-mould defining a first configuration with the periphery of the second part-mould cavity, to form a partially moulded item.

[38] In one embodiment, the method includes the step of disengaging the complementary part-mould defining a first configuration from engagement with the at least one part-mould defining the second part-mould cavity.

[39] In one embodiment, the step of moving the at least one part-mould defining a first part-mould cavity linearly back to a first position includes the step of moving the at least one part-mould defining a second part-mould cavity to a second position.

[40] In one embodiment, the method includes the step of engaging a complementary part-mould defining a third configuration with the second part-mould cavity of the at least one part-mould to present a third mould cavity.

[41] In one embodiment, the third mould cavity is identical in configuration to the second mould cavity.

[42] In one embodiment, the third mould cavity varies in configuration from the second mould cavity.

[43] In one embodiment, the method includes the step of injecting settable material into the third mould cavity formed by the engagement of the at least one part-mould defining the second part-mould cavity with the complementary part-mould defining a third configuration to form a moulded item.

[44] In one embodiment, the method comprises the step of ejecting the moulded item from one or more selected from the second part-mould cavity and the complementary part-mould defining a third configuration.

[45] This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

[46] To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

[47] Other aspects of the invention are also disclosed.

Brief Description of the Drawings

[48] Notwithstanding any other forms which may fall within the scope of the present invention, a preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

[49] **Figure 1** shows an embodiment of the invention as series of views of the apparatus for bi-injection moulding;

[50] **Figure 2** shows a perspective view of the apparatus of **Figure 1**;

[51] **Figure 3** shows a side view of the apparatus exemplifying the movement of the core insert;

[52] **Figure 4** shows a configuration of the embodiment of the invention;

[53] **Figure 5** shows a configuration of the embodiment of the invention;

[54] **Figure 6** shows a configuration of the embodiment of the invention;

[55] **Figure 7** shows a configuration of the embodiment of the invention;

[56] **Figure 8** shows a configuration of the embodiment of the invention;

[57] **Figure 9** shows a configuration of the embodiment of the invention;

[58] **Figure 10** shows a configuration of the embodiment of the invention;

[59] **Figure 11** shows a configuration of the embodiment of the invention; and

[60] **Figure 12** shows a configuration of the embodiment of the invention.

Description of Embodiments

[61] It should be noted in the following description that like or the same reference numerals in different embodiments denote the same or similar features.

[62] A mould positioning arrangement according to an aspect of the invention is generally indicated by the numeral 1000.

[63] In the embodiment **shown in Figures 1-12** now described, the mould positioning arrangement 1000 includes a part-mould (may also be referred to as a core insert) 1200, a moving arrangement 1400 and a complementary part-mould 1300 (may also be referred to as a cavity insert).

[64] In the embodiment shown in **Figures 1 to 3**, the part-mould 1200 is moveable, whereas the complementary part-mould 1300 is kept stationary. It is envisaged in an alternative embodiment that the part-mould 1200 could be kept stationary and the

complementary part-mould 1300 could be moveable, where the important aspect of the functionality of the mould positioning arrangement 1000 is the relative movement of the part-mould 1200 in relation to the complementary part-mould 1300 in a linear fashion.

[65] **Figure 1** exemplifies the process of the movement of the at least one part-mould 1200 in relation to the complementary part-mould 1300 in a chronological sequence. In the chronological sequence, the part-mould 1200 moves back and forward in a linear manner along with a motion of the complementary part-mould 1300 and the part-mould 1200 in a direction towards and away from each other. The moulds 1200, 1300 being moved in a direction away from each other to facilitate the relative linear motion of the part-mould 1200 in relation to the complementary part-mould 1300.

[66] The movement of the part-mould 1200 in respect to the complementary part-mould 1300 is facilitated by a moving arrangement 1400 which will be described in more detail later.

[67] As is shown in **Figure 3**, the part-mould 1200 is linearly moveable between at least two positions (shown as **X** and **Y** in **Figure 3**) and in the embodiment shown is supported by a supporting member 1100. The supporting member 1100 is adapted to allow for the movement of the part-mould 1200 to which it is attached. The movement may be facilitated by the use of sliding tracks or slidable rods among other ways which facilitate linear movement of the part-mould 1200 between its two locations **X** and **Y**.

[68] It is envisaged that the supporting member 1100 may be removable from the part-mould 1200 or alternatively may be an integral part of the part-mould 1200. The removability would aid with maintenance or when a part-mould 1200 needs to be changed to either change the internal mould shape or when it wears out over repeated use.

[69] In operation, the part-mould 1200 and the complementary part mould 1300 are brought together to form a complete mould in which the material to be moulded such as plastic is injected. This process is exemplified in **Figures 4–12** and will be described in further detail later.

[70] The moving arrangement 1400 is adapted to facilitate the linear movement of the part-mould 1200 between its two locations **X** and **Y** (as shown in **Figure 3**). The moving arrangement 1400 may take the form of a hydraulic moving mechanism in the form of a hydraulic ram. The hydraulic ram may be operated by a hydraulic pump which could be actuated with the assistance of an appropriate control system. Appropriate control systems could involve a computer program pre-programmed to control the motion of the moving arrangement 1400 in a predefined fashion.

[71] In another embodiment, the moving arrangement 1400 may include a gearing arrangement removing the necessity for the use of hydraulic systems to move the part-mould 1200 between its two positions. In this embodiment, the gearing arrangement could be a worm gear, helical gear arrangement, a cam arrangement of a rack and pinion arrangement.

[72] The moving arrangement 1400 may be adapted to slide along a low friction shaft allowing for linear movement of the part-mould 1200 between at least two positions. The low friction shaft could either comprise a metallic shaft inserted into a complementary aperture adapted such that the metallic shaft is free to move within the aperture. The aperture would be sized slightly larger than the diameter of the metallic shaft allowing for movement of the shaft within the aperture. A lubricant such as grease or a machine oil would reduce the friction between the shaft and the aperture allowing for low resistance movement of the shaft within the aperture. The motion of the moving arrangement 1400 may be achieved through the use of a hydraulic moving mechanism. It will be appreciated that other methods of actuation may include pneumatic mechanisms which make use of compressed air to force the actuation.

[73] The hydraulic moving mechanism may take the form of a hydraulic ram attached to the part-mould 1200. In another embodiment, the movement of the part-mould 1200 may be achieved using a gear arrangement. Such arrangements may include a worm gear, a cam arrangement or a rack and pinion arrangement.

[74] In a further embodiment, it is envisaged that the moving arrangement 1400 may be a pneumatic moving mechanism using an air pump to provide sufficient pressure to move the part-mould 1200 between its required positions.

[75] Other possible moving arrangements may include a lever mechanism or a rotating threaded shaft. The rotating threaded shaft would be receivable into a complementary threaded member.

[76] The platen may be configured for connection to the part-mould 1200. The means of connection could be bolts screws rivets or welding as a more permanent option. It will be appreciated that it is desirable for the part-mould 1200 to be removable from the moving arrangement 1400 to aid in the maintenance of the mould positioning arrangement 1000.

[77] The part-mould 1200 itself may comprise two or more cavities providing a means for combining more than one material into the part-mould 1200.

[78] The supporting member 1100 is configured for supporting at least the part-mould 1200 which is configured for receiving more than one material typically in the form of molten plastic or any mouldable substance.

[79] In another embodiment, the moving arrangement 1400 may include a lever mechanism in order to amplify the force exerted on the part-mould 1200 when in use.

[80] In another embodiment, the moving arrangement 1400 may include a rotating threaded shaft the rotated threaded shaft being receivable into a complementary threaded member.

[81] The mould positioning arrangement 1000 is configured to move the part-mould 1200 in a predetermined fashion in order to facilitate the injection of the molten plastic into the required part-mould 1200.

[82] As can be seen in **Figure 3** the part-mould 1200 may initially start at position **X** where a first portion of a settable material such as a molten plastic is injected into the part-mould 1200, once the molten plastic has been injected into the part-mould 1200 at position **X** the moving arrangement 1400 is actuated to move the part-mould 1200 to position **Y** in a linear fashion where a second portion of molten plastic is injected into the part-mould 1200 to form a complete moulded item which is then dispensed.

[83] **Figures 4-12** show the steps involved in injecting the moulding material which in this embodiment is in the form of molten plastic into the moulds 1200 and 1300 in order to form the completed product.

[84] In **Figure 4**, we see the relative positioning of the complementary part-mould 1300 in relation to the part-mould 1200 in its open position.

[85] In **Figure 5**, the complementary part-mould 1300 and the part-mould 1200 are bought together in preparation for the injection of the settable material which in this embodiment is molten plastic. As can be seen in **Figure 5**, a cavity 1600 is formed by the closure of the part-mould 1200 with the complementary part-mould 1300. As will be seen in **Figure 6**, the cavity will be injected with the settable material which takes the form of molten plastic.

[86] **Figure 6** shows the injection of the molten plastic through the plurality of passages 1500 and into the part-mould 1200 and complementary part-mould 1300, once the molten plastic has been injected into the complementary part-mould 1300, after which the part-mould 1200 is removed from the complementary part-mould 1300 as is shown in **Figure 7**. The separation of the complementary part-mould 1300 with the part-mould 1200 may be delayed after a predetermined time period to avoid the part-mould 1200 and the complementary part-mould 1300 form being separated while the plastic is still molten which would result in an undesirable distortion of the moulded plastic. The predetermined time period would be dependent on a number of factors including the temperature of the molten plastic and the duration of time it takes for the molten plastic to cool. It will be appreciated by a person skilled

in the art that this time period will largely depend on the type of plastic used in the mould and the temperatures to which they are heated.

[87] In **Figure 8** the part-mould 1200 is moved to its second position **Y** in a linear fashion where a new mould designated as **C** is moved into position where in **Figure 9** the part-mould 1200 and the complementary part-mould 1300 are brought together in preparation for the injection of a second molten plastic of a different material or colour or material.

[88] In **Figure 10**, the second molten plastic is injected into the mould cavity of the complementary part-mould 1300, after which at **Figure 11** the part-mould 1200 and the complementary part-mould 1300 are once again separated from each other.

[89] In **Figure 12**, the completed item is ejected from the complementary part-mould 1300 using a series of plungers 160 after which the process continues.

[90] It will be appreciated by a person skilled in the art that the settable material such as molten plastic would need to set before the part-mould 1200 and the complementary part mould 1300 are separated from each other in order to prevent the moulded item from distorting in shape.

Interpretation

Markush Groups

[91] In addition, where features or aspects of the invention are described in terms of Markush groups, those skilled in the art will recognise that the invention is also thereby described in terms of any individual member or subgroup of members of the Markush group.

Chronological sequence

[92] For the purpose of this specification, where method steps are described in sequence, the sequence does not necessarily mean that the steps are to be carried out in chronological order in that sequence, unless there is no other logical manner of interpreting the sequence.

Embodiments:

[93] Reference throughout this specification to “one embodiment” or “an embodiment” means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases “in one embodiment” or “in an embodiment” in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments.

[94] Similarly it should be appreciated that in the above description of example embodiments of the invention, various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the claims following the Detailed Description of Specific Embodiments are hereby expressly incorporated into this Detailed Description of Specific Embodiments, with each claim standing on its own as a separate embodiment of this invention.

[95] Furthermore, while some embodiments described herein include some but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

Different Instances of Objects

[96] As used herein, unless otherwise specified the use of the ordinal adjectives “first”, “second”, “third”, etc., to describe a common object, merely indicate that different instances of like objects are being referred to, and are not intended to imply that the objects so described must be in a given sequence, either temporally, spatially, in ranking, or in any other manner.

Specific Details

[97] In the description provided herein, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practiced without these specific details. In other instances, well-known methods, structures and techniques have not been shown in detail in order not to obscure an understanding of this description.

Terminology

[98] In describing the preferred embodiment of the invention illustrated in the drawings, specific terminology will be resorted to for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar technical purpose. Terms such as "forward", "rearward", "radially", "peripherally", "upwardly", "downwardly", and the like are used as words of convenience to provide reference points and are not to be construed as limiting terms.

[99] For the purposes of this specification, the term “plastic” shall be construed to mean a general term for a wide range of synthetic or semisynthetic polymerization products, and generally consisting of a hydrocarbon-based polymer.

[100] As used herein the term “and/or” means “and” or “or”, or both.

[101] As used herein “(s)” following a noun means the plural and/or singular forms of the noun.

Comprising and Including

[102] In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” are used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

[103] Any one of the terms: including or which includes or that includes as used herein is also an open term that also means including at least the elements/features that follow the term, but not excluding others. Thus, including is synonymous with and means comprising.

Scope of Invention

[104] Thus, while there has been described what are believed to be the preferred embodiments of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such changes and modifications as fall within the scope of the invention. For example, any formulas given above are merely representative of procedures that may be used. Functionality may be added or deleted from the block diagrams and operations may be interchanged among functional blocks. Steps may be added or deleted to methods described within the scope of the present invention.

[105] Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

Industrial Applicability

[106] It is apparent from the above, that the arrangements described are applicable to the plastics moulding industries.

Claims

The claims defining the invention are as follows:

1. **A moulding device for moulding multicore items by injection moulding, the moulding device comprising:**
    a. a part mould comprising a first part mould cavity and a second part mould cavity;
    b. a complementary part mould defining
        i. a first configuration;
        ii. a second configuration; and
        iii. a third configuration;
    c. a moving arrangement configured for moving the part mould linearly relative to the complementary part mould in a reciprocating movement;
    d. wherein the part mould is reciprocatingly movable relative to the complementary part mould between a first position and a second position;
    e. wherein in the first position the first part mould cavity is engageable with the first configuration of the complementary part mould to define a mould cavity in which an item is mouldable, while simultaneously the second part mould cavity is engageable with the third configuration of the complementary part mould to define a mould cavity in which an item is mouldable;
    f. and wherein in the second position the first part mould cavity is engageable with the second configuration of the complementary part mould to define a second mould cavity in which an item is mouldable, while simultaneously the second part mould cavity is engageable with the first configuration of the complementary part mould to define a mould cavity in which an item is mouldable.

2. The moulding device of claim 1, wherein the complementary part mould includes a plurality of complementary part moulds the plurality of complementary part moulds together defining the first configuration, second configuration and third configuration.

3. The moulding device of claim 1, wherein the part mould includes a plurality of part moulds, the plurality of part moulds together defining the first mould cavity and the second mould cavity.
4. The moulding device of claim 1, wherein the first configuration of the complementary part mould is located centrally of the second configuration and the third configuration.

5. The moulding device of claim 1, including at least one supporting member configured for supporting one or more selected from the part mould and the complementary part mould .

6. The moulding device of claim 1, wherein the moving arrangement includes one or more selected from
    a. a hydraulic moving mechanism;
    b. a gearing arrangement; and
    c. a pneumatic moving mechanism;
    d. a rotating threaded shaft receivable in a complementary threaded member;
    e. a lever mechanism.

7. The moulding device of claim 5, wherein the hydraulic moving mechanism includes a hydraulic ram.

8. The moulding device of claim 5, wherein the gearing arrangement includes one or more selected from a worm gear, a helical gear, a cam arrangement and a rack and pinion arrangement.
9. The moulding device of claim 1, wherein the moving arrangement includes a pneumatic moving mechanism.

10. The moulding device of claim 1, wherein the moving arrangement includes a lever mechanism.

11. The moulding device of claim 1, wherein the moving arrangement includes a rotating threaded shaft.

12. The moulding device of claim 11, wherein the rotating threaded shaft is receivable into a complementary threaded member.

13. The moulding device of claim 1, wherein the at least one part-mould is configured for receiving a first injected material in a first position, and a second injected material in a second position.

14. The moulding device of claim 1, wherein the moulding device includes at least one or more ejector plates for ejecting the fully moulded item.

15. The moulding device of claim 14, wherein the ejector plate includes ejector pins.

16. A method of moulding items to be moulded in a multicore moulding process, the method comprising the steps of:

a. supporting at least one part-mould in a first position, the at least one part-mould including at least a first part-mould cavity and a second part-mould cavity;
b. in the first position, engaging a complementary part-mould defining a first configuration with a periphery of the first part-mould cavity to present a mould cavity in which an item is mouldable, while simultaneously engaging the second part mould cavity with the third configuration of the complementary part mould to define a mould cavity in which an item is mouldable;
c. injecting settable material into the mould cavity formed by the complementary part mould defining a first configuration with the first part mould cavity, while simultaneously injecting settable material into the mould cavity formed by the second part mould cavity with the third configuration of the complementary part mould to form moulded items;
d. disengaging the complementary part-mould defining a first configuration from engagement with first part mould cavity, while simultaneously disengaging the part mould defining the third configuration from engagement with the second part mould cavity;
e. moving the at least one part-mould linearly to a second position;
f. in the second position, engaging a complementary part-mould defining a second configuration with the first part-mould cavity to present a mould cavity, while simultaneously engaging the periphery of the second part-mould cavity with a complementary part mould defining a first configuration to present a mould cavity;
g. injecting settable material into the cavity formed by the engagement of the complementary part mould defining a second configuration with the first part mould cavity to form a moulded item, while simultaneously injecting settable material into the mould cavity formed by the engagement of the second part mould cavity with the complementary part mould defining a first configuration to form a moulded item;
h. disengaging the complementary part mould defining a second configuration with the first part mould cavity while simultaneously disengaging the second

part mould cavity with the complementary part mould defining a third configuration; and

i. moving the at least one part-mould linearly back to the first position.

17. The method of claim 16, wherein the at least one part-mould is a single part-mould that defines a plurality of part-mould cavities.

18. The method of claim 16, wherein the at least one part-mould comprises a plurality of part-moulds, together defining a plurality of part mould cavities.

19. The method of claim 16, wherein the method comprises the step of ejecting the moulded items.