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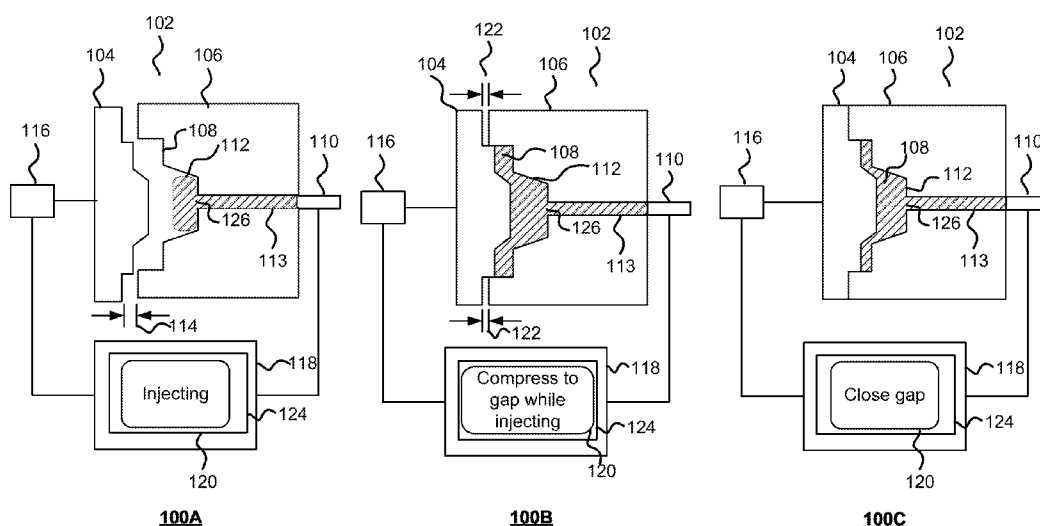
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(54) Title: MOLDING OBJECTS



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FIG. 1

(57) Abstract: Example implementations provide an injection molding kit, the kit comprising at least first and second dies defining a cavity for producing a molded part from a fluid disposed therebetween, at least one of the first and second dies bearing a compression regulator arranged to regulate compression applied to the fluid.

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MOLDING OBJECTS

BACKGROUND

[0001] Injection molding and compression molding are industrial processes that are used to manufacture products and parts from polymers by injecting molten plastic into a mold that is the inverse of the part to be produced. The quality of the resulting product can be adversely affected by several factors such as, for example, warping, shrinkage, surface finish and residual stresses such as, for example, flow-induced residual stress and thermal-induced residual stress.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Example implementations will now be described, by way of example, with reference to the accompanying drawings in which:

[0003] figure 1 shows a schematic view of molding stages according to example implementations;

[0004] figure 2 illustrates a mold assembly comprising a mold according to example implementations;

[0005] figure 3 depicts an expanded view of the mold described with reference to figure 2;

[0006] figure 4A shows the mold assembly comprising a mold according to example implementations;

[0007] figure 4B illustrates the mold assembly comprising a mold according to example implementations;

[0008] figure 5 depicts a pressure or force distribution within a mold according to example implementations;

[0009] figure 6 shows a flowchart of a molding process according to example implementations;

[0010] figure 7 depicts machine-readable storage and machine-executable instructions according to example implementations;

[0011] figure 8 illustrates a product according to example implementations; and

[0012] figure 9 shows a product according to example implementations.

[0013] DETAILED DESCRIPTION

[0014] Referring to figure 1, there are shown several views 100 of injection-compression molding according to example implementations. Referring to figure 100A, there is shown a mold 102. The mold 102 comprises a first, or male member, 104. The mold 102 also

comprises a second, female, member 106. The male and female members cooperate via, for example, complementary formations to define a cavity 108. The cavity, when the male and female members are fully closed, define the shape of a molded product.

5 [0015] An injector 110 is arranged to inject a fluid such as, for example, a melt or charge 112, into the mold cavity 108 while the male and female members 104 and 106 are maintained at a predetermined distance apart 114, that is, the male and female members are not fully mated. The male member 104 can be moved from a first position, that is, a position in which the male and female members 104 and 106 are not fully closed, to a second, or closed, position, that is, to a position in which the male and female members 104 and 106 are fully closed. Since the product is formed during concurrent injection and compression it is known as an injection-compression molded product. An injection-compression molded product can be formed using injection-compression molding processes according to example implementations.

10 [0016] The movement of the male member 104 is under the control of an actuator 116. At least one, or both, of the injector 110 and actuator 116 are responsive to a controller 118. The controller 118 is operable to control at least one or more of the injection speed, injection volume or timing of injecting the fluid 112 into the mold cavity 108. Additionally, the controller 118 can control at least one, or both of the force or pressure, with which the male member 104 is advanced towards, and into, the female member 106, and the timing of such advancement.

15 [0017] The controller 118 is responsive, for example, to circuitry 120 that is executed, or implemented, to control forming an injection-compression molded product according to example implementations. Therefore, the controller 118, in figure 100A, is shown as having circuitry to position the male and female members in close proximity and to actuate the injector 110 to inject the fluid 112 into the cavity 100. When the male and female members are in close proximity, the cavity may or may not be air-tight.

20 [0018] Referring to figure 100B, there is shown a view of the example implementation in which the controller 118, under the control of the circuitry 120, is operable to advance the male member 104, via the actuator 116, into the female member 106, while the injector 110 injects the fluid 112 into the cavity 108 through a channel 113 in the female member 106. It can be appreciated that the degree of compression exerted by the male member 104 on the fluid 112 within the cavity 108 is controlled or limited. The degree of compression so exerted is controlled or limited by, for example, maintaining a predetermined gap 122 or separation between the male and female 104 and 106 members

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during the concurrent compression and injection.

[0019] Referring to figure 100C, there is shown a view of the example implementation in which the predetermined gap 122 is closed after at least one, or both, of a predetermined period of time or in response to a predetermined event. The predetermined event can be, for example, the force with which the male member 104 is inserted into the female member 106 exceeding a predetermined threshold such that the predetermined gap 112 is closed so that the male and female members are fully mated, that is, are in the fully closed position. The controller 118 controls advancing the male member 104 into the female member 106 to urge them towards the fully mated or fully closed position under the control of circuitry 120 that is arranged to control the actuator 116 to close the predetermined gap 122.

[0020] The circuitry 120 described above can be implemented in the form of hardware, software, or a combination of hardware or software. The software can be realised in the form of machine-executable instructions that can be executed, or implemented by, a processor 124.

[0021] By maintaining, or starting with, the predetermined gap 122 while concurrently injecting the fluid 112 into the cavity 108 and then concurrently urging or advancing the male and female members 104 and 106 towards the fully closed position, the pressure experienced by the fluid 112 within the cavity 108 is more evenly distributed, as opposed to being relatively high in and around the region 126 of injection of the fluid 112 into the cavity 108 and relatively low, or decreasing, as the fluid 112 becomes more distal relative to the point 126 of injection of the fluid 112 into the cavity. Furthermore, the fluid 112 is more evenly distributed throughout the cavity 108 during the concurrent compression and injection phase, which improves the yield of the final product. For example, after cooling, the residual stress within the cooled product is much more evenly distributed throughout the whole of the product as compared to the distribution of the residual stress in a cooled product manufactured by injecting the fluid 112 into a fully closed mold.

[0022] Residual stresses are stresses that remain within the molded product without an external load. The residual stresses can be frozen within the part during the molding process and can be a cause of shrinkage and warpage. There are two types of residual stress, which are flow-induced residual stress and thermal-induced residual stress. Flow-induced residual stress can result from the orientation of polymers being fixed in the direction of flow due to the polymers being cooled before they relax to an equilibrium state. This results in the flow-induced stress being frozen into the product.

[0023] Thermal-induced residual stress arises for several reasons such as, for example, uneven material shrinkage during injection molding. For example, the walls of a mold can be at a temperature that is less than that of the polymer in a molten state, such that the polymer can start to solidify at the wall but while the core is still malleable. Such a temperature difference can lead to different cooling rates and, consequently, different thermal-induced stresses.

[0024] Referring to figure 2, there is shown a view 200 of an injection-compression mold assembly that uses a mold according to example implementations. The mold comprises a male, or back, member or die 204, a female, or front, member or die 206 and a middle, or mid-plate, member 208 to be disposed between the back die 204 and the front die 206.

[0025] The back die 204 and the mid-plate 208 are arranged to cooperate via a travel or compression limiter or assembly. The travel or compression limiter or assembly can comprise at least one of a stop pin 210 and a spring 212 disposed between the back die 204 and the mid-plate 208 to provide or maintain the predetermined gap or separation 122 during compression, urging or advancement of the back die 204 towards the front die 206 while the fluid 112 (not shown in figure 2) is injected concurrently into the cavity defined by the back die 204, the front die 206 and the mid-plate 208. The travel or compression limiter or assembly is an example implementation of a compression regulator.

[0026] At least one, or both, of the stop pin 210 and spring 212 is, or are, an example implementation of a spacer or an adjustable spacer. An adjustable spacer can be realised using the spring 212 in combination with a threaded stop pin 210 that can be tightened or loosened according to the degree of bias to be provided by the spring 212.

[0027] The compression-injection die or mold comprising the back die 204, the front die 206, the mid-plate 208 and the compression or travel limiter assembly, in the form of a pin 210 and spring 212, according to example implementations is arranged to cooperate with the remainder of the assembly 200.

[0028] The remainder of the assembly 200 can comprise, viewing figure 2 from left to right, a rear mold base 214 that is arranged to cooperate with a pair of space blocks 216. The space blocks 216 are arranged to accommodate an ejector retainer plate 218. The ejector retainer plate 218 cooperates with a further plate, that is, a thimble plate 220. The rear mold base 214, the space blocks 216, the ejector retainer plate 218 and the back die 204 are held in registry, or otherwise in an aligned position, via a number of pins and screws such as, for example, one or more hex head cap screws 222, one or more ejector guide pins 224, one or more supports 226, one or more guide pins 228 and one or more

thimble pins 230.

[0029] One or more guide bushes 232 are, or can be, arranged to be housed within the mid-plate 208 for receiving the guide pins 228 so that the back die 204 and the mid-plate 208 are correctly aligned. The mid-plate 208 comprises a cavity for receiving a core block 234. The core block 234 is arranged to occupy the cavity of the mid-plate to define the product shape. The core block 234 is arranged to cooperate with a cavity block 236 mounted on, or otherwise coupled to, the front die 206. The cavity block comprises a channel 238 via which the fluid 112 can be injected into the cavity or core block 234. The front die 206 is arranged to receive one or more than one guide bush 240 for receiving the one or more than one guide pin 228. A front die plate 241 is arranged to receive the one or more guide bush 240 and can be coupled to the front die 206, and the remainder of the assembly 200, via one or more than one hex head cap screw 242. There is also provided a locating ring 244 and a sprue bush 246 for coupling the injector 110 to the mold assembly.

[0030] Referring the figure 3, there is shown the back die 204, the front die 206 and the mid-plate 208 together with the one or more than one stop pin 210, the one or more than one spring 212 as well as the one or more than one guide bush 232, the core block 234 and the cavity block 236.

[0031] Referring to figure 4A, there is shown a view 400A of the injection-compression mold assembly in an assembled form. The rear mold base 114 is disposed adjacent to the ejector retainer plates 218 and 220. The rear mold base 114 is held in a spaced apart relationship relative to the back die 204 via the supports 226 and the one or more thimble pins 230. The one or more than one spring 212 held within the mid-plate 208 is biased to urge the back die 204 away from the mid-plate 208, which maintains, during compression, that is, during urging or advancing the back die 204 towards the front die 206, the predetermined gap 122. The one or more than one stop pin 212 is arranged to limit the travel of the back die 204 towards the front die 206, which limits the compression applied to the fluid 112 held within, or adjacent to the core block 234, which more evenly distributes the pressure throughout the mold cavity 108.

[0032] The front die 206 accommodates the cavity block 236. The cavity block 236 comprises a channel 402 that is aligned with a corresponding channel 404 and a further channel 406 in the front die 206 and the front die plate 241 respectively.

[0033] It can be seen that the one or more than one stop pin has yet to engage with the front die 206 such that there is a spaced apart relationship between the back die 204 and

the mid-plate 208 maintained via the spring 212 that controls or otherwise limits the compression experienced by the fluid 112 in the cavity 108 during the compression while injecting the fluid 112 according to example implementations.

[0034] It can be appreciated, in the example implementation shown in figure 4B, that the back die 204, mid-plate 208 and front die 206 are in the fully closed position. The one or more than one stop pin 212 limits the compression that can be applied to the fluid 112 within the mold.

[0035] Referring to figure 5, there is shown a view 500 of the distribution of force or pressure experienced within the cavity 108 according to an example implementation. For simplicity, that is, for the purposes of explanation, the male member 104, or the back die 204, and the female member 106, or the front die 206, are shown. At least one of maintaining the gap 122 while injecting or compressing while injecting results in a more uniform distribution of pressure 502, which is in contrast the prior art distribution of pressure 504, which is non-uniform. However, such an even distribution of pressure or force follows also in example implementations that use a mold comprising the back die 204, the front die 206 and the mid-plate 208. By advancing the male member 104 or back die 204 to produce compression while concurrently injecting the fluid and during the final phase leading to the fully closed position of the mold, the fluid 112 is more evenly distributed throughout the cavity, which also results in a more even distribution of pressure throughout the fluid 112. The more evenly distributed pressure throughout the fluid 112 results in a more evenly distributed residual stress throughout the end product.

[0036] Referring to figure 6, there is shown a flowchart 600 according to an example implementation. At 602, the mold dies such as, for example, the male and female members 104 and 106, or the back die 204, mid-plate 208 or front die 206, are held in a spaced apart relationship in preparation for receiving the fluid 112. The injection of the fluid 112 commences at 604. While the fluid 112 is being injected, the male member 104, or the back die 204, is urged towards the female member 106, or the front die 206, at 606 in such a manner to maintain the predetermined separation 122 between the male member 104, or the back die 204, and the female member 106, or the front die 206. The predetermined separation is maintained for a predetermined period of time and/or until a predetermined condition has been reached. After the predetermined period of time has lapsed, or after the predetermined condition has been reached, the male member 104 or the back die 204, is further urged or moved towards the female member 106, or the front die 206, to close the predetermined gap 122 and, therefore, to close fully the mold. The

fluid 112 within the mold cavity 108 is allowed to cool, at 608, in preparation for removing the molded product from the dies. At 610, the dies are separated and the molded product is removed.

[0037] It will be appreciated that circuitry as used herein can comprise one or more than one of physical electronic circuitry, software (such as machine-readable and machine-executable instructions), hardware, or application specific integrated circuitry, taken jointly or severally in any and all permutations.

[0038] Therefore, implementations also provide machine-readable storage storing such machine-executable instructions. The machine-readable storage can comprise transitory or non-transitory machine-readable storage. The machine can comprise one or more processors, or other circuitry, for executing the instructions or implementing the instructions. The above described processor 124 is an example of such one or more processors or such other circuitry.

[0039] Accordingly, referring to figure 7, there is shown a view 700 of implementations of at least one of machine-executable instructions or machine-readable storage. Figure 7 shows machine-readable storage 702. The machine-readable storage 702 can be realised using any type of volatile or non-volatile storage such as, for example, memory, a ROM, RAM, EEPROM, or other electrical storage, or magnetic or optical storage or the like. The machine-readable storage 702 can be transitory or non-transitory. The machine-readable storage 702 stores machine-executable instructions (MEIs) 704. The MEIs 704 comprise instructions that are executable by a processor or other instruction execution, or instruction implementation, circuitry 706. The processor or other circuitry 706 is responsive to executing or implementing the MEIs 704 to perform any and all activities, operations, or methods described and/or claimed in this application such as the operations described with reference to at least one or more than one of figures 1 to 6, in particular for realising the processing corresponding to figure 6.

[0040] The processor or other circuitry 706 can output one or more than one control signal 708 for controlling or otherwise actuating, via respective actuators 710, the dies of the molds according to example implementations described and/or claimed in this application.

[0041] The MEIs 704 can comprise MEIs to implement the flowchart of figure 6 or any part thereof taken jointly and severally with any other part thereof, and/or any method described herein. Therefore, for example, the MEIs 704 can comprise at least one of MEIs 712 to position the dies to maintain the gap 122, MEIs 714 to compress the dies while injecting the charge or melt or MEIs 716 to fully close the dies taken jointly and severally

in any and all permutations.

[0042] Referring to figure 8, there is shown a view 800 of a product 802 according to an example implementation using the above-described molds and methods. In the implementation shown, the product is a microlens 802 array. Example implementations can be realized in which the microlens array is a double-sided microlens array. The implementations of the microlens array can be fabricated from a polycarbonate material that is injected into the mold. The microlens array 802 can comprise at least one microlens such as, for example, a first microlens 804. The first microlens 804 can be one of a plurality of microlens such as, for example, first 804 and second 806 microlenses. At least one of the first 804 and second 806 microlenses can form part of at least one set of microlenses such as, for example, a first set 808 of microlenses. The first set 808 of microlenses can be one of a plurality of sets of microlenses. In the example implementation shown, the microlens array 802 comprises a number of sets of microlenses such as, for example, the eight sets of microlenses 808 to 822 depicted. A set of microlenses can comprise a plurality of microlenses. In the example shown, a set of microlenses comprises four microlenses such as microlenses 824 to 830 depicted, but could comprise some the number of microlenses.

[0043] Example implementations of the microlens array 802 can be realized in which the plurality of sets of microlens are regularly distributed. Example implementations can be realized that distribute the sets of microlens in at least one, or both, of equidistant radially disposed microlenses or equiangularly circumferentially disposed microlens. The microlens array 802 can have a predetermined thickness 832. Example implementations can be realized in which the predetermined thickness 832 is 0.8mm.

[0044] Example implementations can be realized in which one or more than one microlens, or all microlenses, such as, for example, the first microlens 804 is formed in, or on, a pair of surfaces 834 and 836. The microlens 804 comprises a first face 838. The first face 838 can be a convex face. The convex face 838 can have a predetermined radius of curvature. Example implementations can be realized in which the predetermined radius of curvature can be 1.1mm or some other radius of curvature. The first convex face 838 can have a predetermined diameter 840. Example implementations can be realized in which the predetermined diameter 840 can be 1.38mm or some other diameter. The convex face 838 can be a spherical convex face.

[0045] The microlens 804 can comprise a second face 842. The second face 842 can be a concave face. The concave face 842 can have a predetermined radius of curvature.

Example implementations can be realized in which the predetermined radius of curvature can be 2.5mm or some other radius of curvature. The concave face 842 can have a predetermined diameter 844. Example implementations can be realized in which the predetermined diameter 844 can be 1.38mm or some other diameter. The concave face 842 can be a spherical convex face.

[0046] Example implementations can be realized in which a first face of a microlens can be concave or convex and/or the second face of the microlens can be concave or convex. Therefore, example implementations can be realized in which a microlens has a pair of concave faces, a pair of convex faces or a concave face and a convex face.

[0047] Referring to figure 9, there is shown a view 900 of a first product 902 according to an example implementation and a prior art product 904. Each product 902 and 904 has an associated residual stress profile 906 and 908 respectively. The residual stress profile 906 associated with the first product 906 indicates that the residual stress is at least one, or both, of low or uniform. The residual stress profile 908 associated with the prior art product 904 is at least one, or both, of higher than that of the first product 902 or non-uniform. Concentric rings 910 to 918 are used to represent regions of different or varying residual stress in the product 904. The variation in residual stress across a product can be viewed or determined using a polarimeter due the residual stress affecting the polarization or rotation of light passing through product.

[0048] Although example implementations have been described with reference to the product 802/902 being a microlens array, example implementations are not limited to such an implementation. Example implementations can be realized in which the product is a housing. The housing could be the housing of a computer or other electronic device such as, for example, a laptop, a tablet, a mobile phone or any other injection-compression molded housing.

[0049] Implementations can be realised in accordance with the following examples.

[0050] In some examples, described is an injection molding kit, the kit comprising at least first and second dies defining a cavity for producing a molded part from a fluid disposed therebetween, at least one of the first and second dies bearing a compression regulator arranged to regulate compression applied to the fluid.

[0051] In some examples, the compression regulator comprises a spacer arranged for setting a first predetermined proximal distance between the first and second dies.

[0052] In some examples, the compression regulator comprises an adjustable spacer arranged to set a variable first predetermined or minimal proximal distance between the

first and second dies.

[0053] In some examples, the spacer comprises a stop pin.

[0054] In some examples, the compression regulator comprises a biasing member for urging at least one of the compression regulator, the first or second die in a predetermined direction. For example, example implementations can be realised in which the spring urges the stop pin in a predetermined direction.

[0055] In some examples, the injection molding kit further comprises a third die such as, for example, the mid-plate, to be disposed between the first and second dies.

[0056] In some examples, the third die is adapted to carry the compression regulator.

[0057] In some examples, the compression regulator is arranged to regulate compression applied to the fluid by biasing the first and second dies away from one another.

[0058] In some examples, the compression regulator is arranged to regulate compression applied to the fluid by maintaining a predetermined gap or separation between first and second dies.

[0059] In some examples, described is an injection molding assembly comprising an injection molding kit of any preceding clause, a fluid injection unit, at least one actuator for moving at least one of the first and second dies and a controller to control at least one of the fluid injection unit or said at least one actuator, the controller being arranged to maintain a predetermined separation between the first and second dies while injecting the fluid into the cavity.

[0060] In some examples, described is an injection molding machine comprising at least first and second dies defining a cavity to receive a charge or melt to form an injection-compression molded product; the machine comprising a controller arranged to move the first and second die from an open state to a closed state via an intermediate state; the intermediate state being arranged to maintain a predetermined separation between the first and second dies while concurrently injecting the charge or melt into the cavity.

[0061] In some examples, the controller is arranged to maintain the intermediate state for a predetermined period of time.

[0062] In some examples, the controller is arranged to urge the first and second dies towards the closed state.

[0063] In some examples, the predetermined period of time has a sufficient duration to allow at least one of stress or strain within the fluid with the cavity to reduce.

[0064] In some examples, the injection molding machine is operable according to one or more than one of the following parameters: a predetermined mold temperature, such as,

for example 60-80 C, an injection temperature such as, for example, between 300-360C, or 300C; a predetermined injection time such as, for example, 5 to 15s, or 10s; a predetermined compression time such as, for example, 2 to 8s, or 5s; a predetermined cap hold time such as, for example, 0.2 to 0.5s, or 0.35s; a predetermined gap size such as, for example, 0.5-15.mm, or 1mm; a predetermined gap compression such as, for example, 4-6 tons, or 5.6 tons; a predetermined fully closed compression such as, for example, 12-17 tons, or 14.6 tons, a predetermined mold wall temperature such as, for example, 50C to 90C, or 70C, taken jointly and severally in any and all permutations.

[0065] In some examples, described is an injection molding method for molding product using at least first and second dies defining a cavity for producing a molded part from a fluid disposed therebetween, at least one of the first and second dies bearing a compression regulator arranged to regulate compression applied to the fluid; the method comprising maintaining the first and second dies at a predetermined separation while concurrently injecting the fluid into the cavity.

[0066] In some examples, the method comprises urging at least the first and second dies together while concurrently injecting the fluid into the cavity.

[0067] In some examples, the method comprises urging at least the first and second dies towards, or into, a closed position.

[0068] In some examples, the method comprises urging at least the first and second dies towards, or into, a closed position while concurrently injecting the fluid into the cavity.

[0069] In some examples, the method comprises regulating compression applied to the fluid by biasing the first and second dies away from one another.

[0070] In some examples, the method comprises regulating compression applied to the fluid by maintaining a predetermined gap or separation between first and second dies.

[0071] In some examples, described is an injection molding method using at least first and second dies defining a cavity to receive a charge or melt to form an injection-compression molded product; the machine comprising a controller arranged to move the first and second dies from an open state to a closed state via an intermediate state; the method comprising maintaining at least the first and second dies in the intermediate state having a predetermined separation between the first and second dies while concurrently injecting the charge or melt into the cavity.

[0072] In some examples, the method comprises maintaining the intermediate state for a predetermined period of time.

[0073] In some examples, the method comprises urging the first and second dies towards

the closed state.

[0074] In some examples, the method comprises allowing a predetermined period of time to allow at least one, or both, of stress or strain within the fluid within the cavity to reduce.

[0075] In some examples, the method comprises at least one of the following:

[0076] establishing a predetermined mold temperature, such as, for example 60-80 C,

[0077] establishing an injection temperature such as, for example, between 300-360C, or 300C;

[0078] establishing a predetermined injection time such as, for example, 5 to 15s, or 10s;

[0079] establishing a predetermined compression time such as, for example, 2 to 8s, or 5s;

[0080] establishing a predetermined cap hold time such as, for example, 0.2 to 0.5s, or 0.35s;

[0081] establishing a predetermined gap size such as, for example, 0.5-15.mm, or 1mm;

[0082] establishing a predetermined gap compression such as, for example, 4-6 tons, or 5.6 tons;

[0083] establishing a predetermined fully closed compression such as, for example, 12-17 tons, or 14.6 tons, or

[0084] establishing a predetermined mold wall temperature such as, for example, 50C to 90C, or 70C,

[0085] the foregoing being taken jointly and severally in any and all permutations.

[0086] In some examples, described are machine-executable instructions arranged, when executed or implemented, to realise any method described herein.

[0087] In some examples, described is machine-readable storage storing such machine-executable instructions.

[0088] In some examples, described is a product fabricated according to any method described herein.

[0089] In some examples, described is a product comprising a substantially uniform residual stress.

[0090] In some examples, the product comprises at least one or more than one lens.

[0091] In some examples, the at least one or more than one lens is a microlens.

[0092] In some examples, the at least one or more than one lens has a predetermined surface profile.

[0093] In some examples, the predetermined surface profile is at least one of curved, spherical or cylindrical.

[0094] In some examples, the predetermined surface profile has a respective predetermined radius of curvature.

[0095] In some examples, the predetermined radius of curvature is one of 1.1mm or 2.5mm.

5 [0096] In some examples, the lens has a predetermined diameter.

[0097] In some examples, the predetermined diameter is 1.38mm.

[0098] In some examples, the at least one or more than one lens comprises a plurality of sets of lenses.

[0099] In some examples, a set of lenses comprises a predetermined number of lenses.

10 [00100] In some examples, the predetermined number of lenses comprises four lenses.

[00101] In some examples, the plurality of sets of lenses are regularly disposed relative to one another.

15 [00102] In some examples, the plurality of sets of lenses are equiangularly disposed relative to one another.

CLAIMS

1. An injection molding kit, the kit comprising
 - a. at least first and second dies defining a cavity for producing a molded part from a fluid disposed therebetween, at least one of the first and second dies bearing a compression regulator arranged to regulate compression applied to the fluid.
2. The injection molding kit of claim 1, in which the compression regulator comprises a spacer arranged for setting a first predetermined proximal distance between the first and second dies.
3. The injection molding kit of claim 1, in which the compression regulator comprises an adjustable spacer arranged to set a variable first predetermined or minimal proximal distance between the first and second dies.
4. The injection molding kit of claim 2, in which the spacer comprises a stop pin.
5. The injection molding kit of claim 1, in which the compression regulator comprises a biasing member for urging at least one of the compression regulator or the first or second dies in a predetermined direction.
6. The injection molding kit of claim 1, further comprising a third die to be disposed between the first and second dies.
7. The injection molding kit of claim 6, in which the third die is adapted to carry the compression regulator.
8. The injection molding kit of claim 1, in which the compression regulator is arranged to regulate compression applied to the fluid by biasing the first and second dies away from one another.
9. The injection molding kit of claim 1, in which the compression regulator is arranged to regulate compression applied to the fluid by maintaining a predetermined gap or separation between first and second dies.
10. An injection molding method using at least first and second dies defining a cavity to receive a charge or melt to form an injection-compression molded product; the method comprising moving the first and second dies from an open state to a closed state via an intermediate

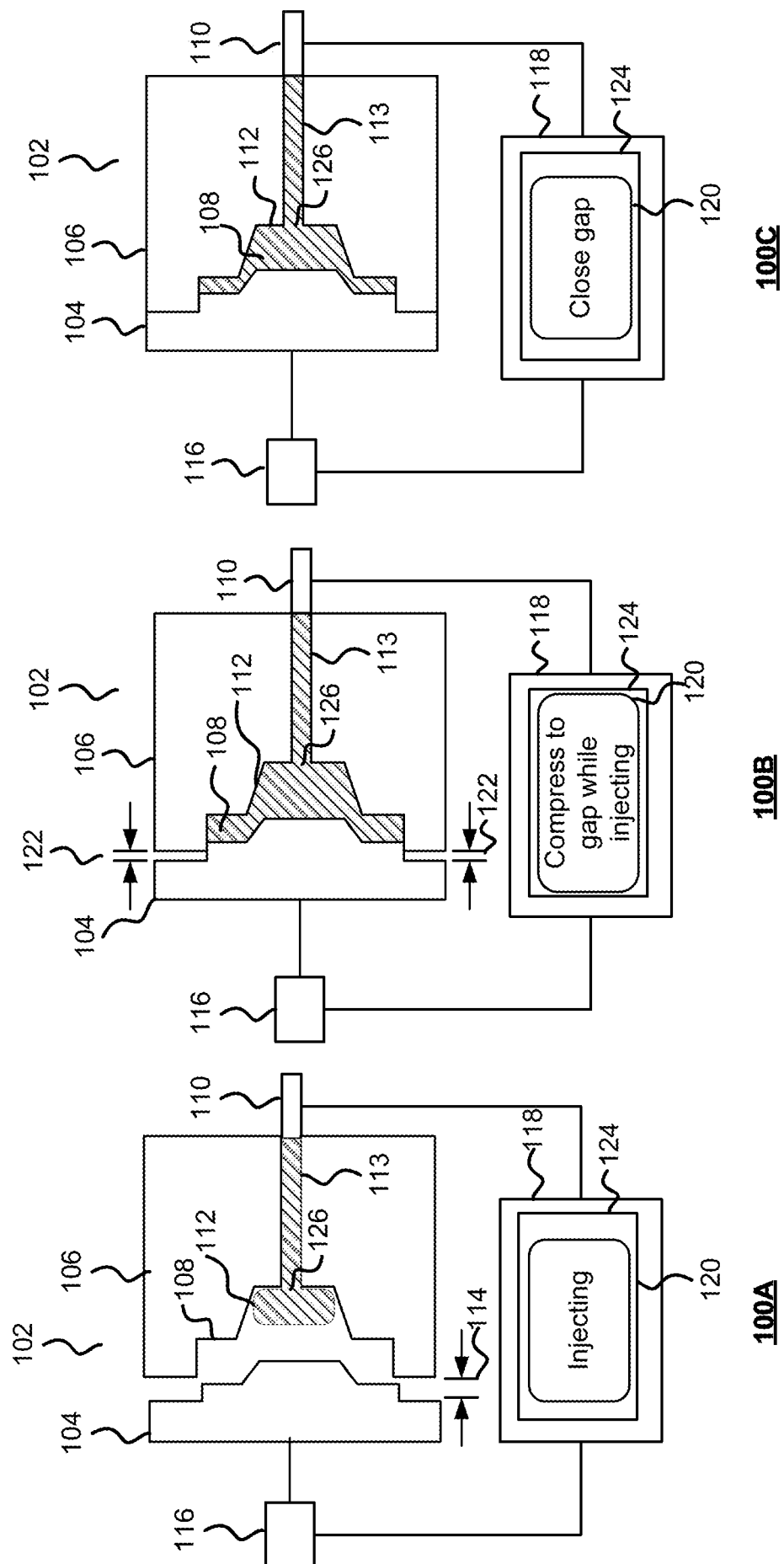
state; said moving comprising maintaining at least the first and second dies in the intermediate state having a predetermined separation between the first and second dies while concurrently injecting the charge or melt into the cavity.

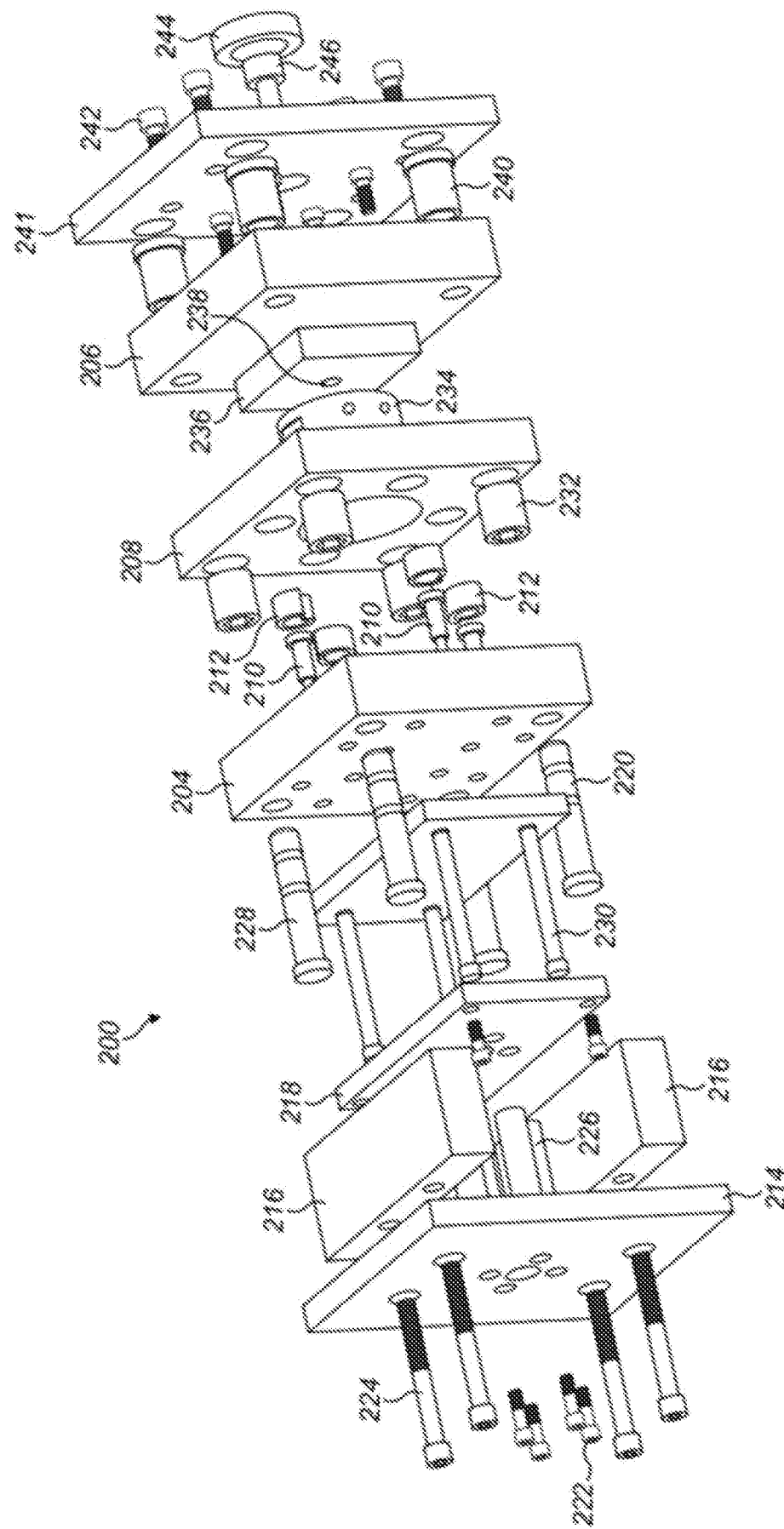
5 11. The method of claim 10, comprising maintaining the intermediate state for a predetermined period of time.

12. The method of claim 11, comprising urging the first and second dies towards the closed state.

13. The method of claim 12, comprising allowing a predetermined period of time to allow at least one of stress or strain within the fluid within the cavity to reduce.

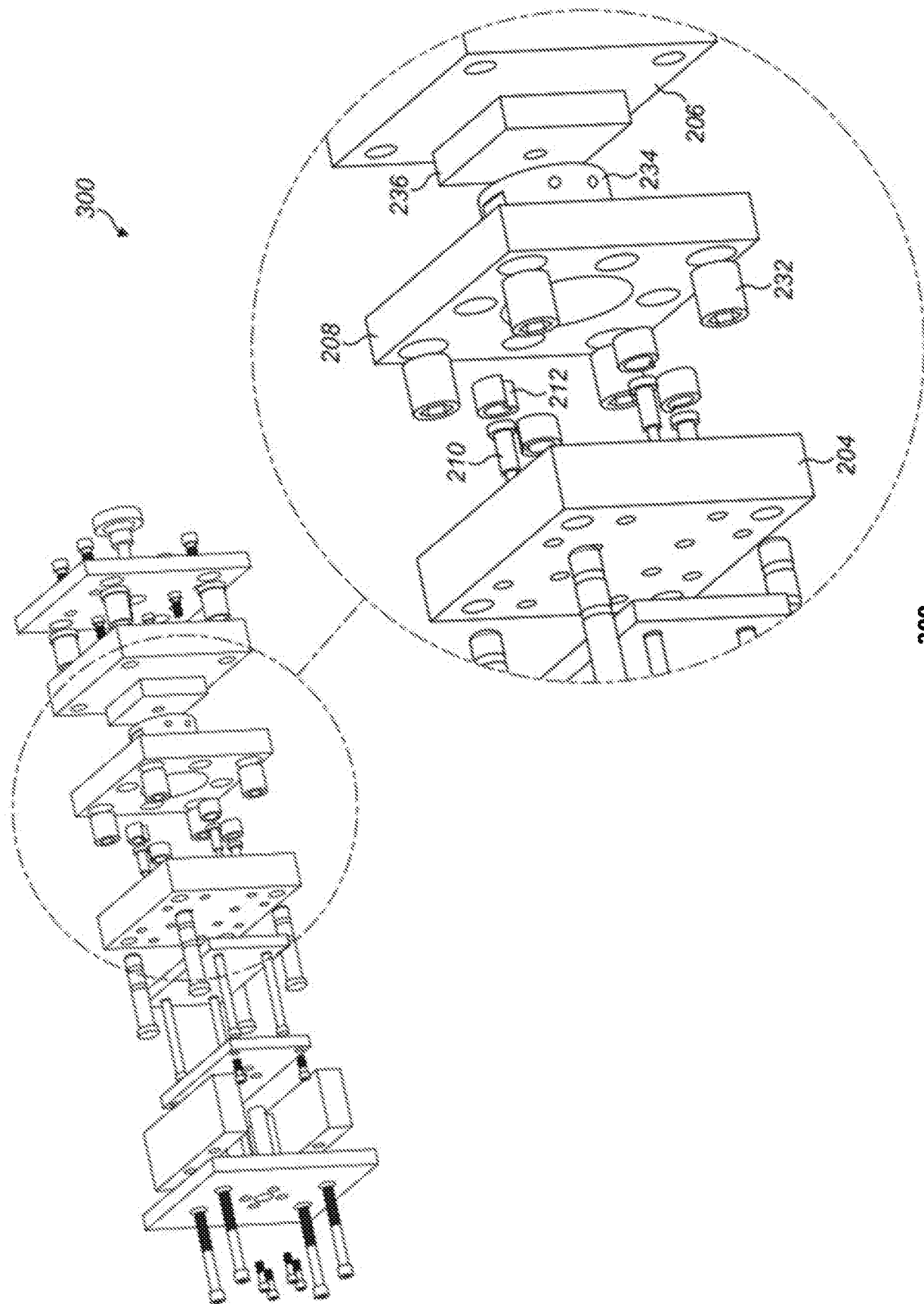
10 14. A product produced according to the method of claim 10.





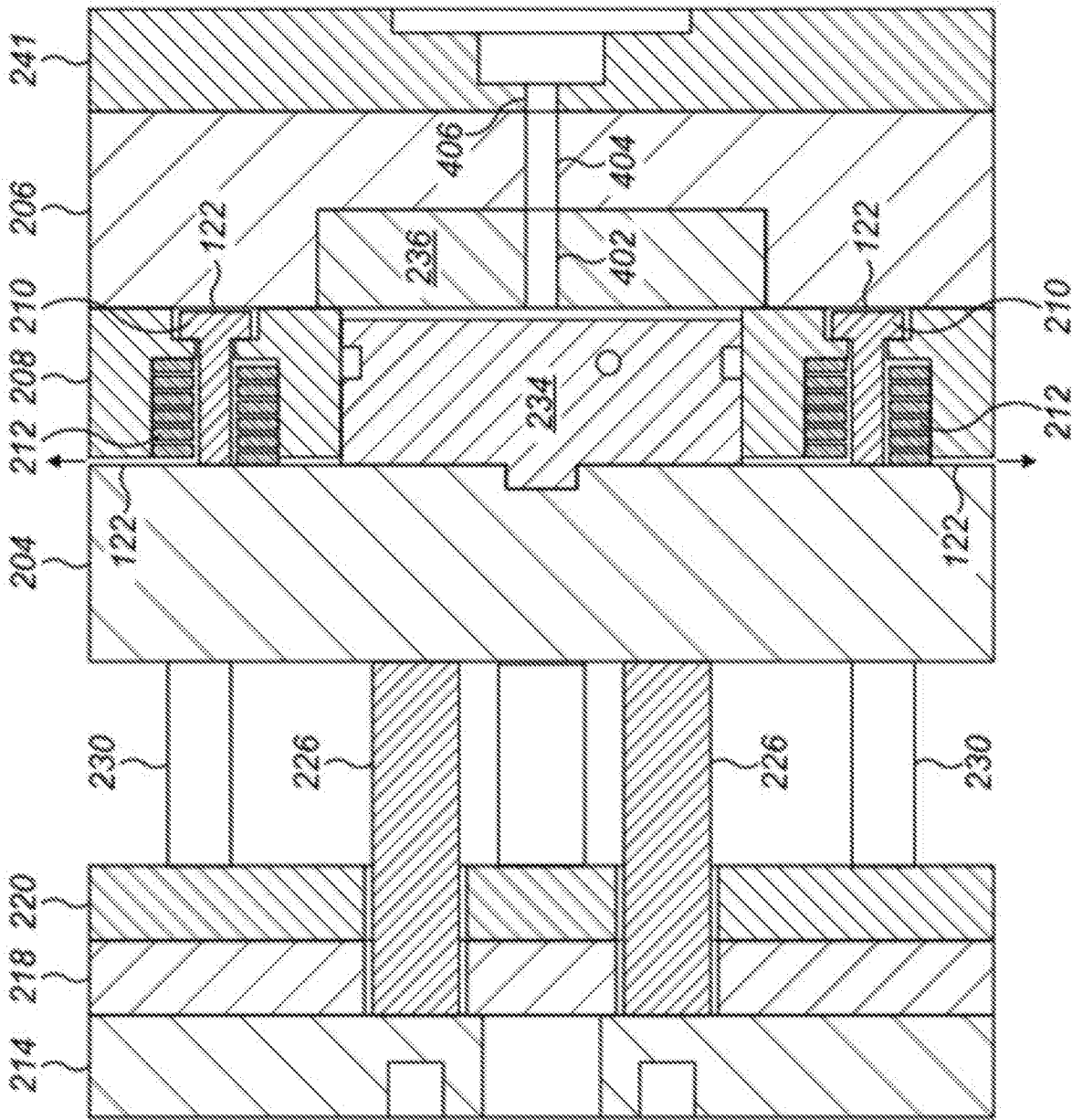
200

FIG 2



300

FIG. 3



400A

FIG. 4A

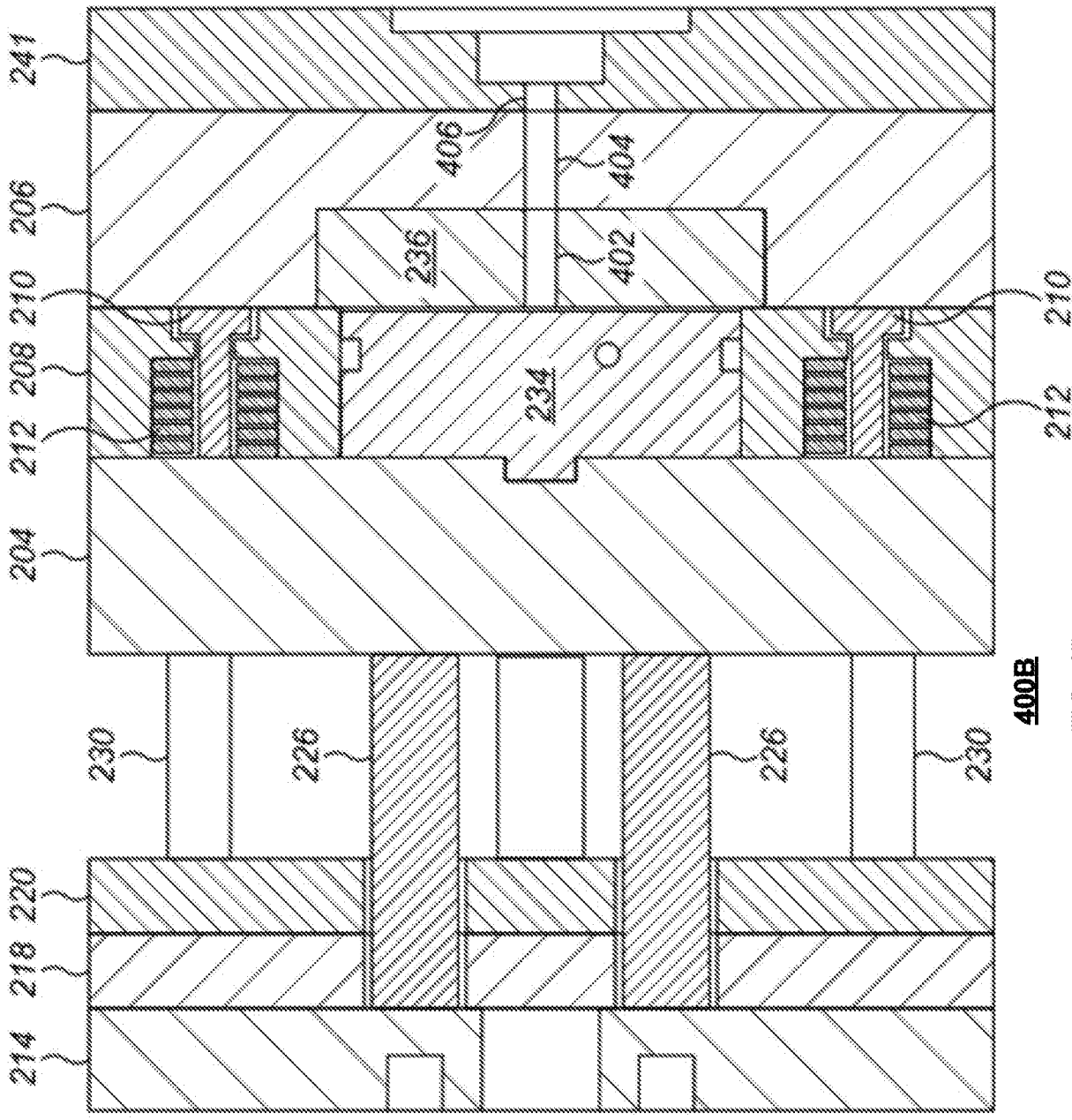
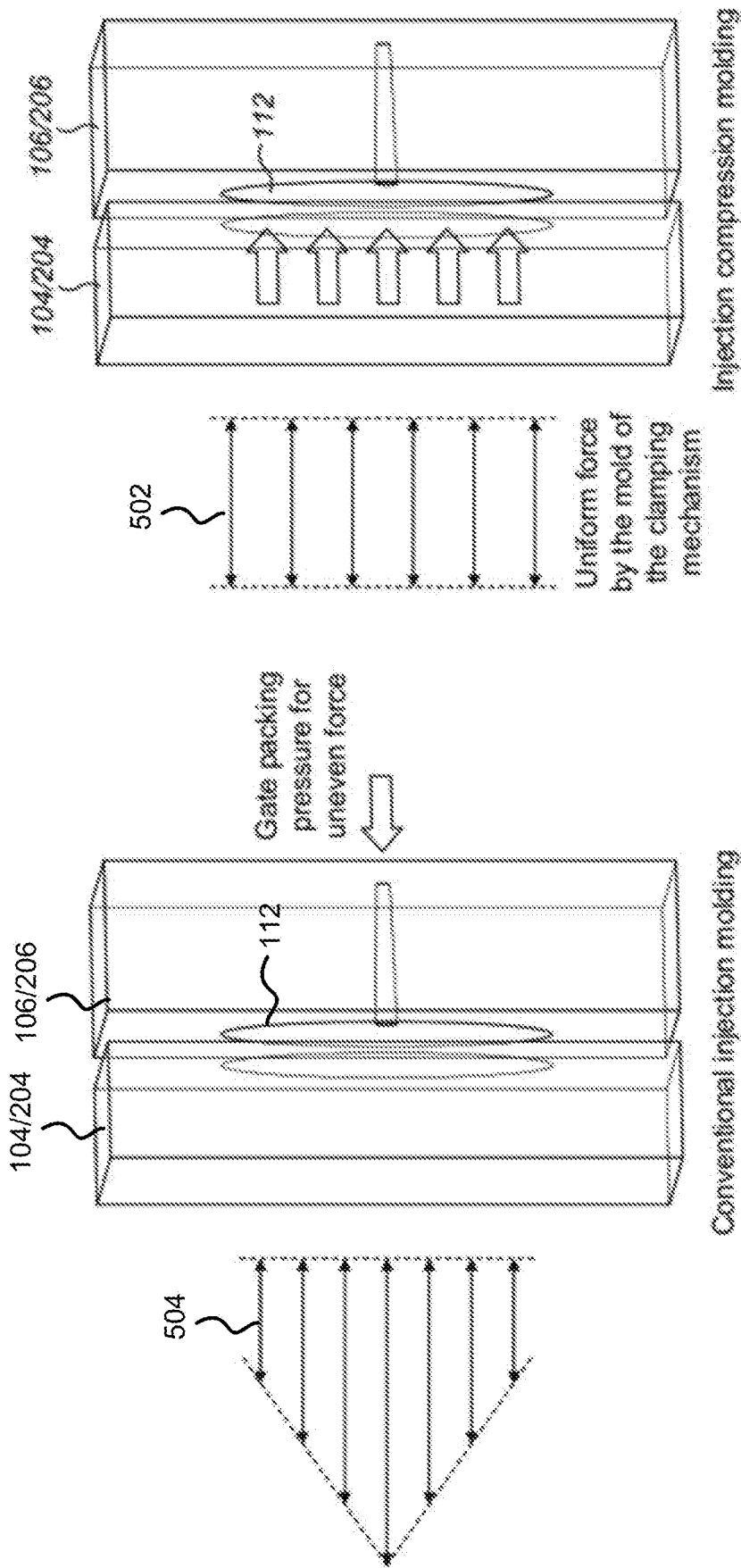


FIG. 4B



500

FIG. 5

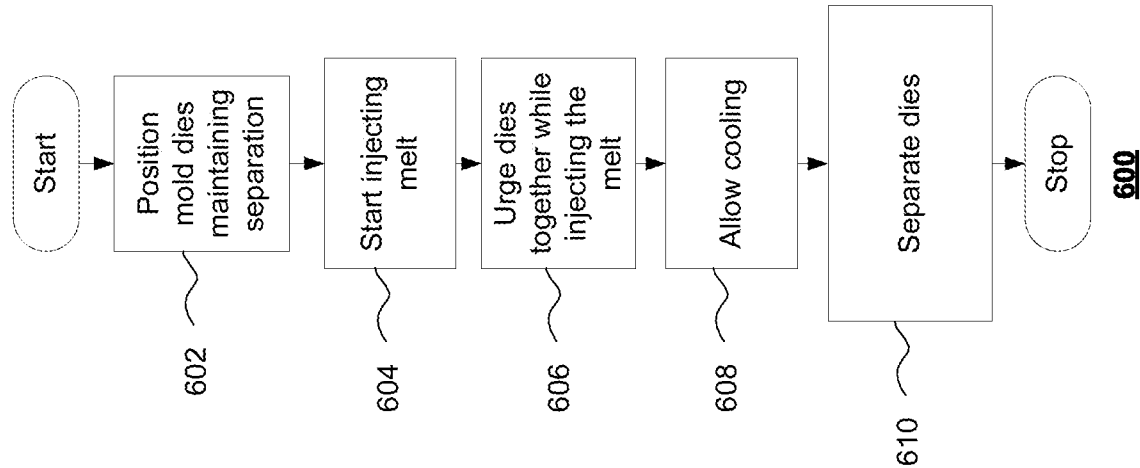


FIG. 6

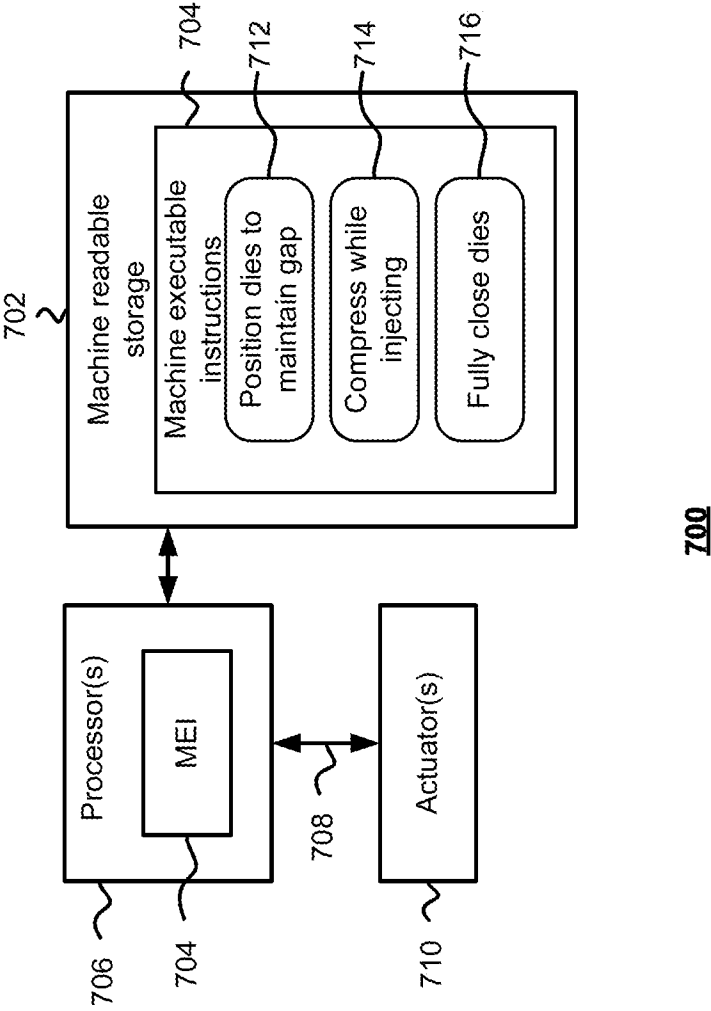
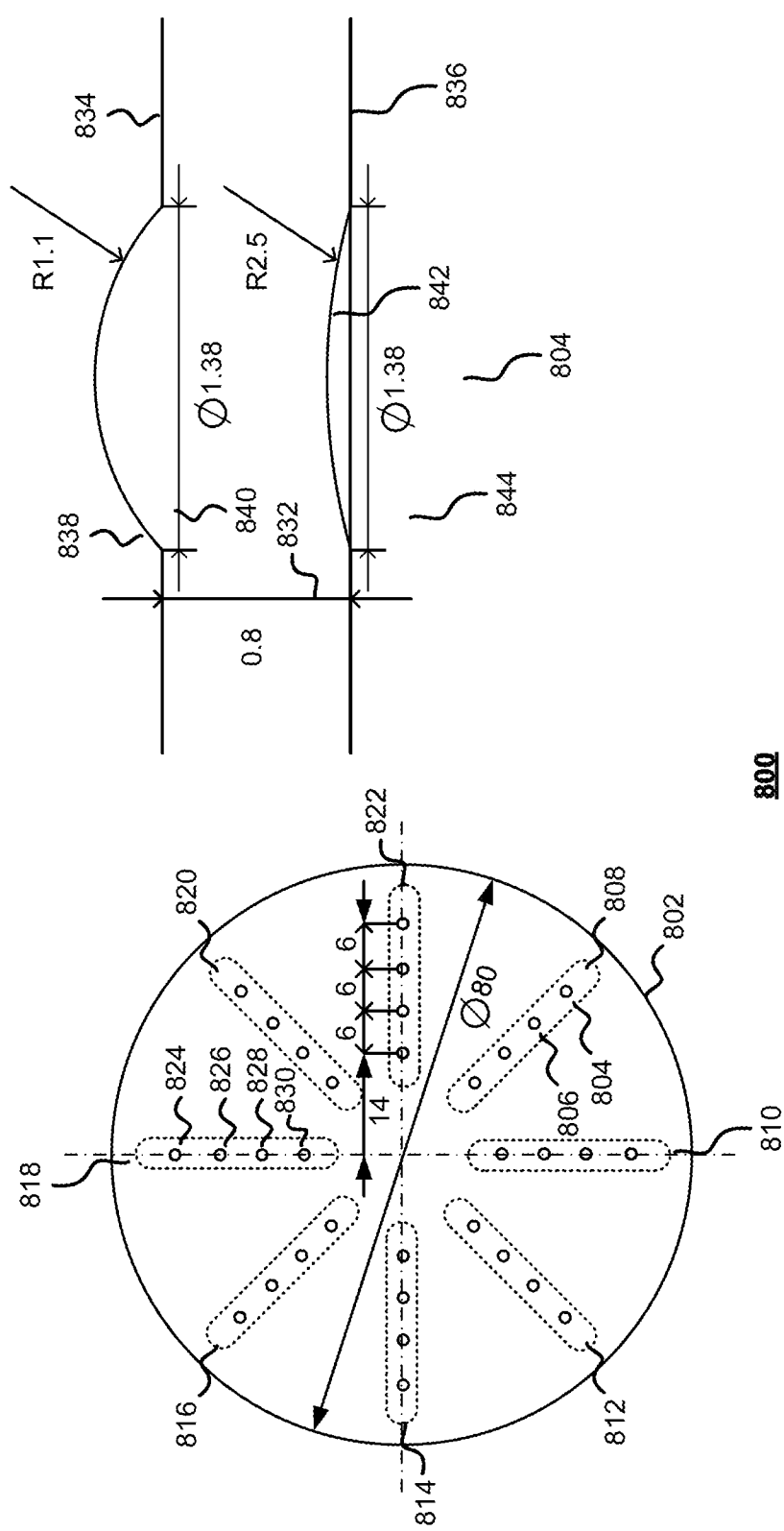
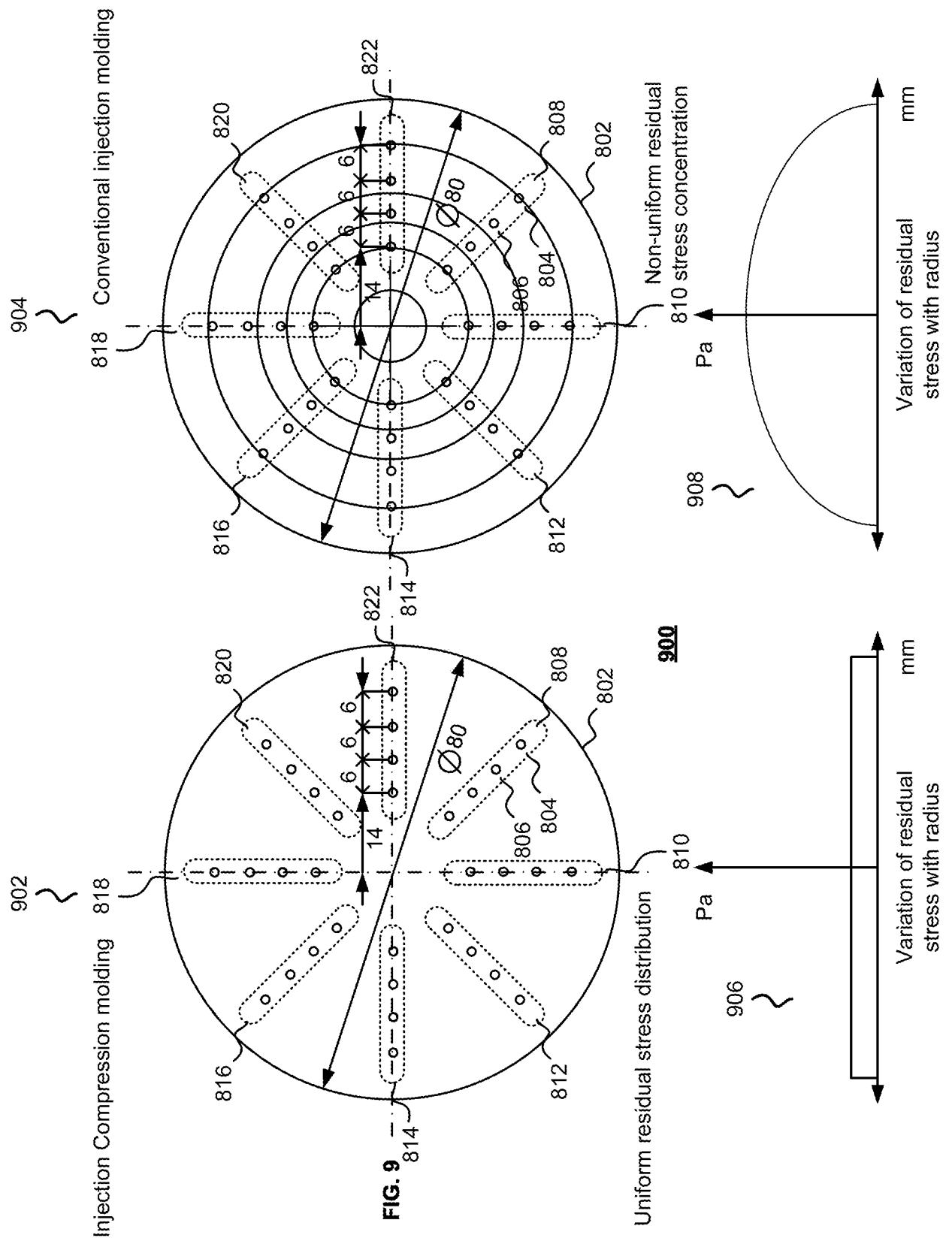


FIG. 7



800



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2019/016456

A. CLASSIFICATION OF SUBJECT MATTER B29C 45/04 (2006.01) B29C 45/46 (2006.01) B29C 45/64 (2006.01) According to International Patent Classification (IPC) or to both national classification and IPC				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) B29C Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSearch (RUPTO internal), Espacenet, DWPI, PAJ, USPTO				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 6736628 B1 (ZENO ZUFFA) 18.05.2004, claims 1,11, fig. 3,4	1,3-5,8-14		
Y		2,6,7		
Y	WO 2007/000930 A1 (NISSHA PRINTING; FUJIMURA TOSHIT- SUGU) 04.01.2007, fig. 1-4,6,17,claims 1,4,7, abstract	2,6,7		
Y	WO 02/068171A1 (CEBAL; BOSSHARDT MICHEL; GRUAU BERT -RAND) 06. 09.2002, claim 1	6,7		
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.				
* Special categories of cited documents: <table border="0"> <tr> <td style="vertical-align: top;"> “A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier document but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed </td> <td style="vertical-align: top;"> “T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family </td> </tr> </table>			“A” document defining the general state of the art which is not considered to be of particular relevance “E” earlier document but published on or after the international filing date “L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) “O” document referring to an oral disclosure, use, exhibition or other means “P” document published prior to the international filing date but later than the priority date claimed	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention “X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone “Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art “&” document member of the same patent family
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Date of the actual completion of the international search 25 September 2019 (25.09.2019)		Date of mailing of the international search report 07 November 2019 (07.11.2019)		
Name and mailing address of the ISA/RU: Federal Institute of Industrial Property, Berezhkovskaya nab., 30-1, Moscow, G-59, GSP-3, Russia, 125993 Facsimile No: (8-495) 531-63-18, (8-499) 243-33-37		Authorized officer A. Brazhnikova Telephone No. (499) 240-25-91		