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(54) Title: ADJUSTABLE LENGTH CONDITIONING PINS

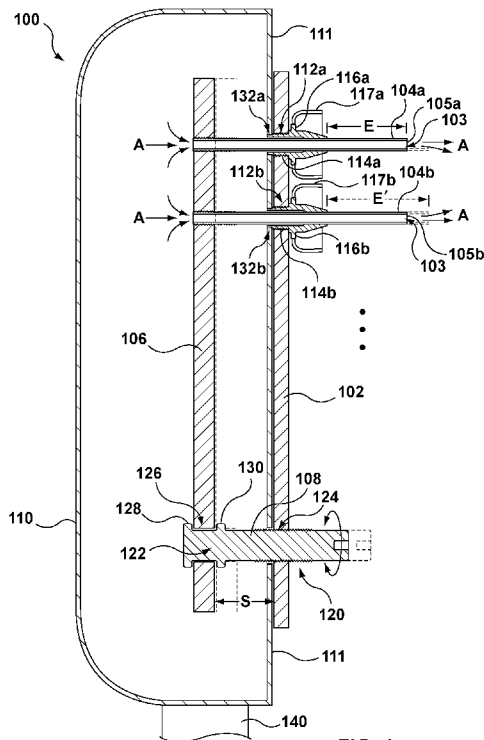


FIG. 1

(57) Abstract: An apparatus for conditioning molded articles, such as preforms, that have been removed from a mold may comprise a plate and a plurality of conditioning pins extending through the plate. Each of the conditioning pins may be configured for applying a conditioning fluid to a surface of a molded article. The apparatus may include an adjustment mechanism for adjusting an exposed length the plurality of conditioning pins by moving the conditioning pins relative to the plate. The adjustable-length conditioning pins may be used for post-mold conditioning of various types of articles having various form factors. The adjustment of the length of the conditioning pins may be wholly or partly automated by a control system incorporating an actuator. The control system may include a controller whose operation is governed, at least in part, by controller-executable instructions loaded from a non-transitory computer-readable medium.

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ADJUSTABLE LENGTH CONDITIONING PINS**TECHNICAL FIELD**

5 The present disclosure relates to, but is not limited to, the conditioning of molded articles removed from a mold, and more particularly relates to, but is not limited to, the use of adjustable length conditioning pins to apply a conditioning fluid to molded articles removed from a mold.

BACKGROUND

10 Molding is a process by which a molded article can be formed from molding material using a molding system. Various molded articles can be formed using a molding process, such as an injection molding process. One example of a molded article that can be formed is a preform that is capable of being subsequently blow-molded into a beverage container, such as a bottle or the like. The molding material may be a resin or plastic material, such as polyethylene terephthalate (PET) for example.

15 As an illustration, injection molding of PET material involves heating the PET material (e.g. PET pellets, PEN powder, PLA, etc.) to a homogeneous molten state and injecting, under pressure, the melted PET material into a molding cavity defined, at least in part, by a female cavity piece and a male core piece mounted respectively on a cavity plate and a core plate of the mold. The cavity plate and the core plate are urged together and are held together by clamp force, the clamp force being
20 sufficient for keeping the cavity and the core pieces together against the pressure of the injected PET material. The molding cavity has a shape that substantially corresponds to a final cold-state shape of the molded article. The injected PET material is then cooled to a temperature sufficient to enable ejection of the so-formed molded article from the mold. When cooled, the molded article shrinks
25 inside of the molding cavity and, as such, when the cavity and core plates are urged apart, the molded article tends to remain associated with the core piece of the mold. Accordingly, by urging the core plate away from the cavity plate, the molded article can be de-molded. Ejection structures that may be used to assist in removing the molded articles from the core half may include stripper plates, ejector pins, and others. Alternatively, in some cases the molded articles may tend to remain
30 associated with the cavity half of a mold and may need to be ejected therefrom.

Once molded articles have been removed from the mold, the molded articles may be subjected to a post-mold conditioning process, e.g. in parallel with the next injection cycle of the molding machine. One such form of post-mold conditioning is cooling of the molded articles. Post-mold cooling may
35 serve one or more purposes.

One purpose of post-mold cooling may be to maximize a quality of the molded articles. For example, when articles are molded from semi-crystalline resins such as PET, improper or insufficient post-mold cooling may be detrimental to article quality. The reason is that, when proper cooling is not performed (e.g. when cooling is performed too slowly), the resin may wholly or partially crystallize, thereby weakening or otherwise degrading the quality of the molded article. The risk of crystallization may be particularly high in the hottest areas of the molded articles.

For example, in the case where the molded articles are preforms, the closed end of the preform, which may have a dome shape, may be one of the hottest areas of the article just after molding (“post-mold”), because that area is typically proximate to the hot stem of a hot runner injection nozzle during molding. This closed end of the preform may be referred to as the “gate area” of the preform, because it is typically proximate to the gate of the hot runner that is used to inject melted molding material into the mold. Insufficient cooling of the gate area of the preform may result in an undesirable degree of crystallization of the PET material in that area. This may in turn be detrimental to proper stretching of the molding material in that area during subsequent blow-molding. Another area of a preform that may be susceptible to crystallization is the open neck area or “neck finish portion.” The reason is that, because the wall of the neck finish is typically thicker than that of other areas of the preform, post-mold heat retention in that area may be higher than in other areas.

Another possible purpose of post-mold cooling may be to minimize mold cycle time. Mold cycle time may refer to a duration between a point in time when the cavity and core mold halves are closed for forming the molded articles and a subsequent point in time when the mold halves are opened and the molded articles are removed. Generally, a shorter cycle time is preferred, as this increases the number of molded articles that can be produced by a particular mold over a given time period. The post-mold cooling process may help to minimize cycle time by allowing the duration of an in-mold cooling phase, just after injection molding, to be minimized.

SUMMARY

According to one aspect of the present disclosure, there is provided an apparatus for conditioning molded articles that have been removed from a mold, the apparatus comprising: a plate; a plurality of conditioning pins extending through the plate, each of the conditioning pins for applying a conditioning fluid to a surface of a molded article; and an adjustment mechanism for adjusting an exposed length of the plurality of conditioning pins by way of relative movement between the conditioning pins and the plate.

In some embodiments, each of the conditioning pins is attached to a frame and the adjusting comprises moving the frame relative to the plate.

5 In some embodiments, the apparatus further comprises a plenum, the plenum containing the conditioning fluid under pressure, the frame is situated within the plenum, and the plate is situated outside of the plenum and in fixed relation to an external face of the plenum.

10 In some embodiments, the adjustment mechanism comprises a screw having a threaded portion, the threaded portion being received within a threaded hole in one of the plate and the frame, the screw further comprising an unthreaded portion that is rotatably received by, and longitudinally fixed with respect to, the other of the plate and the frame.

15 In some embodiments, the apparatus further comprises a plurality of cups mounted on one side of the plate and in fixed relation to the plate, with an open end of each cup facing outwardly from the plate, each of the cups having a base with an opening therein and a respective one of the conditioning pins extending through the opening into the cup.

In some embodiments, the conditioning is cooling and the conditioning fluid is pressurized air.

20 In some embodiments, the molded articles comprise preforms and each of the conditioning pins has at least one outlet for directing the conditioning fluid onto an interior surface of a closed end the preform.

25 In some embodiments, the apparatus further comprises an actuator for actuating the adjustment mechanism responsive to a control signal.

In some embodiments, each of the conditioning pins has at least one outlet at or near a distal end of the conditioning pin.

30 According to another aspect of the present disclosure, there is provided an apparatus for conditioning a plurality of articles removed from a mold, each of the articles being a molded container having an open neck, the apparatus comprising: a plurality of cups oriented in the same direction and being in fixed relation to one another, each of the cups being sized for encompassing the open neck of a respective one of the molded containers, each of the cups further having a base with an opening
35 therethrough; a plurality of conditioning pins in fixed relation to one another, each of the conditioning pins being configured for applying a conditioning fluid to an interior of a respective one

of the molded containers, each of the conditioning pins extending through the opening in the base of a respective one of the cups and into the cup; and an adjustment mechanism for moving the plurality of conditioning pins relative to the plurality of cups to adjust a distance between a distal end of each conditioning pin and the respective cup, wherein each cup is configured for causing the conditioning fluid exiting the interior of the respective one of the molded containers to be redirected to flow about an exterior of the open neck.

In some embodiments, the apparatus further comprises a plate, and each of the cups is fixedly mounted, directly or indirectly, to the plate.

In some embodiments, the molded containers are preforms and each of the conditioning pins has at least one outlet for applying the conditioning fluid to the interior of a respective one of the preforms.

According to another aspect of the present disclosure, there is provided a non-transitory computer-readable medium storing instructions that, when executed by a controller associated with a post-mold article conditioning apparatus having a plurality of adjustable-length conditioning pins, cause the controller to: determine a target length of the adjustable-length conditioning pins; based on the determined target length of the adjustable-length conditioning pins, automatically compute an adjustment to be made to the adjustable-length conditioning pins for attaining the target length; and output a signal for causing an actuator to effect the adjustment to the adjustable-length conditioning pins.

In some embodiments, the controller has an associated human-machine interface and the determining comprises inputting, via the human-machine interface, an indication of the target length of the adjustable-length conditioning pins.

In some embodiments, the instructions further cause the controller to input, via a human-machine interface associated with the controller, an article identifier uniquely identifying an article to be conditioned by the post-mold article conditioning apparatus, and the determining of the target length of the adjustable-length conditioning pins comprises mapping the article identifier to the target length of the adjustable-length conditioning pins.

In some embodiments, the inputting of the article identifier comprises receiving, via the human-machine interface, a selection of one of a plurality of selectable options displayed in a user-interface control, each selectable option being associated with a unique article identifier.

In some embodiments, the automatically computing of the adjustment to be made to the adjustable-length conditioning pins comprises: determining a current length (E) of the adjustable-length conditioning pins; and computing a difference between a current length of the adjustable-length conditioning pins and the target length of the adjustable-length conditioning pins.

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In some embodiments, the instructions further cause the controller to input, via a sensor associated with the controller, an indicator of a type, a form factor, or a dimension of an article to be molded, and the determining of the target length of the adjustable-length conditioning pins comprises mapping the indicator to the target length of the adjustable-length conditioning pins.

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In some embodiments, the indicator that is input via the sensor is encoded on a mold component that is specific to the article to be molded.

In some embodiments, the instructions further cause the controller to input, via a sensor associated with the controller, an indicator of the target length of the adjustable-length conditioning pins to be used for conditioning the article.

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These and other aspects and features of non-limiting embodiments will now become apparent to those skilled in the art upon review of the following description of specific non-limiting embodiments in conjunction with the accompanying drawings.

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DESCRIPTION OF THE DRAWINGS

The non-limiting embodiments will be more fully appreciated by reference to the accompanying drawings, in which:

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FIG. 1 illustrates, in cross-section, an apparatus for conditioning molded articles that have been removed from a mold

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FIG. 2 schematically illustrates an injection molding system incorporating the apparatus of FIG. 1;

FIG. 3 illustrates a conditioning pin of the apparatus of FIG. 1 conditioning a molded article held within a receptacle of a take-off device;

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FIG. 4 is a schematic representation of a system that may be used to control the apparatus of FIG. 1;

FIG. 5 is a flowchart illustrating operation of the apparatus of FIG. 1; and

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FIG. 6 is a user interface that may be presented on a human-machine interface of the system of FIG. 2.

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an understanding of the embodiments or that render other details difficult to perceive may have been omitted.

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DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

Reference will now be made in detail to various non-limiting embodiment(s) of an apparatus for conditioning molded articles. It should be understood that other non-limiting embodiment(s),
5 modifications and equivalents will be evident to one of ordinary skill in the art in view of the non-limiting embodiment(s) disclosed herein and that these variants should be considered to be within scope of the appended claims.

Furthermore, it will be recognized by one of ordinary skill in the art that certain structural and
10 operational details of the non-limiting embodiment(s) discussed hereafter may be modified or omitted (i.e. non-essential) altogether. In other instances, well known methods, procedures, and components have not been described in detail.

In this document, any use of the term “exemplary” should be understood to mean “an example of”
15 and not necessarily to mean that the example is preferable or optimal in some way.

Referring to FIG. 1, an exemplary embodiment of an apparatus 100 for conditioning molded articles (or “conditioning apparatus”) 100 is illustrated. In the present example, the apparatus 100 is used to cool molded articles, specifically preforms, that have been removed from a mold. However, as will
20 be described, alternative embodiments may perform different types of conditioning upon other types of molded articles.

As illustrated, the exemplary apparatus 100 comprises a plate 102, a plurality of conditioning pins 104a, 104b (referred to generically and collectively as conditioning pin(s) 104) extending through the
25 plate 102, a frame 106 to which the conditioning pins 104 are attached, an adjustment mechanism 108, and a plenum 110.

The plate 102, which may in some embodiments be referred to by the trademark CoolJet™ or CoolPik™ (e.g. a “CoolJet™ plate” or a “CoolPik™ plate”), has a plurality of holes 112a, 112b
30 (referred to generically and collectively as hole(s) 112) therethrough. Each hole 112a, 112b has a respective conditioning pin 104a, 104b extending therethrough, with each pin 104 being free to move longitudinally relative to the plate 102.

In the illustrated embodiment, each hole 112a, 112b is fitted with a respective collar 114a, 114b
35 (referred to generically and collectively as collar(s) 114) that is in fixed relation to the plate 102 through which the respective conditioning pin 104a, 104b extends. Each of the collars 114a, 114b has

a respective annular flange 116a, 116b (referred to generically and collectively as flange(s) 116). Each flange 116a, 116b has attached thereto a cup-like structure or “cup” 117a, 117b (referred to generically and collectively as cup(s) 117). The purpose of the cups 117 is described below. In some
5 indirectly, e.g. via collars. The collars 114 and/or cups 117 may be omitted in alternative embodiments.

The conditioning pins 104 are for applying the conditioning fluid, which is pressurized air in the present example, to a surface of a molded article, which is a preform in this example. Because the
10 type of conditioning that is performed by the illustrated embodiment is cooling of molded articles, the conditioning pins of this embodiment may be referred to as cooling pins. Although only two conditioning pins 104a, 104b are illustrated in FIG. 1 for the sake of clarity, it will be appreciated that the number of conditioning pins in alternative embodiment may be greater than two. For example, the number of conditioning pins 104 may correspond to the number of preforms molded
15 during a single molding cycle of an associated molding system, which may be several hundred for example. Alternatively, the number of conditioning pins may be a multiple of a number of preforms 232 molded during a single molding cycle. In other words, the apparatus 100 may cool multiple sets of molded articles, with each set possibly being at a different stage of cooling.

Each of the conditioning pins 104a, 104b of the present embodiment is an elongate rigid tube with an
20 outlet 103 at its distal end 105a, 105b (referred to herein generically and collectively as distal end(s) 105). This design allows the distal end 105 of each conditioning pin 104 to be positioned proximately to the interior surface of the closed end (or “gate area”) of the preform to be cooled upon insertion of the conditioning pin 104 into the preform. Such proximate positioning may facilitate or expedite
25 cooling of the closed end of the preform upon emission of pressurized air from the outlet 103. Put another way, each conditioning pin 104 of the present embodiment may be considered to act essentially as an elongate nozzle whose tip can be positioned close to an interior surface of the closed end of an article to be cooled, so that a stream of pressurized air may be applied directly to that area of the article.

Each cup 117 is sized to loosely receive (e.g. encompass without touching) the open neck area of a
30 respective one of the preforms, which may be referred to as the “neck finish portion” of the preform and may have the appearance of a threaded bottle opening. The cup 117 has a base 119 and an opening 121 in the base through which the conditioning pin 104 extends, into and through the cup (as shown in FIG. 3, discussed below). Each cup 117 is configured (e.g. shaped) so as to cause air
35 exiting the interior of the respective preform (i.e. air that has been blown into the preform by the

conditioning pin 104) to be redirected to flow about an exterior of the open neck area of the preform. The cup 117 may accordingly facilitate or enhance cooling of the neck finish of the preform or, more generally, may facilitate conditioning of the open neck area of a molded article that is a container. An example of this will be shown in FIG. 3 (discussed below).

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All of the conditioning pins 104 of the present embodiment are of uniform length. This may be considered a typical arrangement but is not necessarily true in all embodiments.

As shown in FIG. 1, the exposed length of each conditioning pin 104, i.e. the portion that extends from the respective collar 114, is denoted E. As will be described below, the apparatus 100 allows the exposed length E to be easily adjusted. This facilitates reconfiguration of the apparatus 100 for cooling preforms of different lengths or, more generally, for conditioning different types and form factors of molded articles, as described below.

The frame 106 serves as a common point of attachment for each of the conditioning pins 104 and facilitates movement of the conditioning pins 104 in unison. In the present embodiment, the conditioning pins 104 are removably attached to the frame 106 by way of threaded ends. This is not necessarily true in all embodiments. For example, the pins may be removably attached using other means or may be permanently attached. The frame 106 may be aligned with the plate 102 by way of leader pins (not depicted). In some embodiments, the frame 106 may be a plate.

The adjustment mechanism 108 allows the exposed length E of the conditioning pins 104 to be adjusted. The adjustment mechanism 108 of the present embodiment comprises a screw having a threaded portion 120 and an unthreaded portion 122. The threaded portion 120 is received within a threaded hole 124 in plate 102. The unthreaded portion is rotatably received by, and is longitudinally fixed with respect to, the frame 106. In other words, the screw cannot be moved along its longitudinal axis relative to the frame 106 but can rotate relative to the frame. In the present embodiment, this is achieved by way of annular flanges 128 and 130 on the screw that sandwich the frame therebetween and thereby prevent, or limit to a minimal degree, longitudinal movement of the screw with respect to the frame 106. The unthreaded portion 122 of the screw extends through a hole 126 in the frame 106 and is free to rotate therewithin.

Rotation of the screw causes the exposed length E of the conditioning pin 104 to be adjusted as follows. The rotation causes the separation S between the frame 106 and the plate 102 to increase or decrease. This in turn causes the pins 104 to extend from, or retract into (depending upon the

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direction of rotation of the screw), the plate 102. In view of this adjustability, the conditioning pins 104 may be referred to as adjustable-length conditioning pins 104.

5 The plenum 110 supplies conditioning fluid under pressure to the conditioning pins 104 for application to molded articles. In the case where the conditioning fluid is pressurized air, as in the illustrated example, the plenum 110 may comprise an air pressurizing device such as a blower (not depicted). The plenum 110 of FIG. 1 comprises a closed container. Operationally, the internal air pressure within the container will be greater than ambient pressure. The pressure differential will force air, represented by arrows A in FIG. 1, out through the conditioning pins 104. Air may flow
10 continuously throughout operation of the apparatus.

In the illustrated embodiment, the frame 106 is situated within the plenum 110, while the plate 102 is situated outside of the plenum 110. The plate 102 is in fixed relation to an external face 111 of the plenum, e.g. attached to the plenum using suitable fasteners (not depicted).

15 The face 111 of the plenum 110 has a plurality of holes 132a, 132b therethrough (referred to collectively or generically hole(s) 132). The holes 132 are aligned with the holes 112 in the plate 102, described above. This permits the conditioning pins 104 to extend through both the face 111 of the plenum 110 and the plate 102. In the present embodiment, the collars 114 that are seated within
20 holes 112 also extend into the holes 132. The collars 114 may accordingly help form a seal for limiting egress of pressurized air from the plenum 110. Nevertheless, some degree of air egress or leakage, e.g. through the annular region between the conditioning pin 104 and the edges of holes 112 and 132, may occur and may be considered acceptable or tolerable. The collars 114 may also facilitate longitudinal sliding of the conditioning pins 104 through the holes 112 and 132, i.e. may
25 facilitate slidable extension of the pins through the holes.

It should be understood that the apparatus 100 may have other configurations and the description presented above has been provided as an example only and is not intended to be limiting. In other non-limiting embodiments, the apparatus can have other configurations with more or fewer
30 components.

FIG. 2 illustrates the apparatus 100 in the context of a non-limiting embodiment of a molding system 200. The illustrated molding system 200 is an injection molding system. However, it should be understood that in alternative non-limiting embodiments, the molding system 200 may comprise
35 other types of molding systems, such as, but not limited to, compression molding systems, metal molding systems or the like. Indeed, the apparatus 100 could be used with molding systems

incorporating any multi-cavitation mold, including PET molds, thinwall articles molds, closures molds or the like. Alternatively, the apparatus 100 could be used in other contexts or could be independently commercialized.

5 The example molding system 200 of FIG. 2 comprises a fixed platen 202 and a movable platen 204. The apparatus 100 is mounted to the movable platen 204 by way of support 140. As a result, the apparatus 100 moves along with the movable platen 204 as the movable platen 204 reciprocates. The molding system 200 further comprises an injection unit 206 for plasticizing and injection of molding material.

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In operation, the movable platen 204 reciprocates, i.e. is moved towards and away from the fixed platen 202, by means of stroke cylinders (not shown) or any other suitable means. Clamp force, also referred to as closure or mold closure tonnage, can be developed within the molding system 200, for example, by using tie bars 208, 210 and a tie-bar clamping mechanism 212, as well as (typically) an associated hydraulic system (not depicted) that is usually associated with the tie-bar clamping mechanism 212. It will be appreciated that clamp tonnage can be generated using alternative means, such as, for example, using a toggle-clamp arrangement (not depicted) or the like.

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A first mold half 214 can be associated with the fixed platen 202 and a second mold half 216 can be associated with the movable platen 204. These two mold halves may be considered to collectively comprise a mold 217. In the specific non-limiting embodiment of FIG. 2, the first mold half 214 comprises one or more mold cavities 218. As will be appreciated by those of skill in the art, the one or more mold cavities 218 may be formed by using suitable mold inserts or any other suitable means. As such, the first mold half 214 can be generally thought of as a "cavity mold half." The second mold half 216 comprises one or more mold cores 220 complementary to the one or more mold cavities 218. As will be appreciated by those of skill in the art, the one or more mold cores 220 may be formed by using suitable mold inserts or any other suitable means. As such, the second mold half 216 can be generally thought of as a "core mold half."

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30 The first mold half 214 can be coupled to the fixed platen 202 by any suitable means, such as a suitable fastener (not depicted) or the like. The second mold half 216 can be coupled to the movable platen 204 by any suitable means, such as a suitable fastener (not depicted) or the like. It should be understood that in an alternative non-limiting embodiment, the position of the first mold half 214 and the second mold half 216 can be reversed and, as such, the first mold half 214 can be associated with the movable platen 204 and the second mold half 216 can be associated with the fixed platen 202.

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In alternative non-limiting embodiments, the fixed platen 202 need not be stationary and may as well be moved in relation to other components of the molding system 200.

FIG. 2 depicts the first mold half 214 and the second mold half 216 in a so-called "mold open position" where the movable platen 204 is positioned generally away from the fixed platen 202 and, accordingly, the first mold half 214 is positioned generally away from the second mold half 216. The distance separating the plenum 110 and the take-off device 228 is denoted P. In the mold open position, a molded article can be removed from the first mold half 214 and/or the second mold half 216. In a so-called "mold closed position" (not depicted), the first mold half 214 and the second mold half 216 are urged together, by means of movement of the movable platen 204 towards the fixed platen 202, and cooperate to define (at least in part) a molding cavity (not depicted) into which the molding material can be injected. It should be appreciated that one of the first mold half 214 and the second mold half 216 can be associated with a number of additional mold elements, such as for example, one or more leader pins (not depicted) and one or more leader bushings (not depicted), the one or more leader pins cooperating with one more leader bushings to assist in alignment of the first mold half 214 with the second mold half 216 in the mold closed position.

The example molding system 200 can further comprise a robot 222 operatively coupled to the fixed platen 202. The robot 222 comprises a mounting structure 224, an actuating arm 226 coupled to the mounting structure 224 and a take-off device 228 (alternatively referred to as an "end of arm device") coupled to the actuating arm 226.

The take-off device 228 comprises a plurality of molded article receptacles 230. The purpose of the plurality of molded article receptacles 230 is to remove molded articles (in this case, preforms 232) from mold cores 220 or mold cavities 218 and to hold the molded articles during post-mold cooling. In the specific non-limiting example being illustrated herein, each of the molded article receptacles 230 comprises a tube for receiving and holding a single molded preform during cooling. The number of receptacles 230 in the take-off device 228 may match a number of preforms 232 molded during a single molding cycle. Alternatively, the number of receptacles 230 may be a multiple of a number of preforms 232 molded during a single molding cycle. In other words, the take-off device 228 may hold multiple sets of molded articles at different stages of cooling, with one set (or possibly more than one set) being cooled by the apparatus 100 at any given time.

The molding system 200 may further comprise additional components, such as a hot runner (not depicted) associated, for example, with the fixed platen 202. Furthermore, the molding system 200 may optionally or additionally comprise auxiliary equipment (not depicted), such as dehumidifiers,

heaters and the like. It should be understood that the molding system 200 may have other configurations and the description presented above has been provided as an example only and is not intended to be limiting. In other non-limiting embodiments of the present invention, the molding system 200 can have other configurations with more or fewer components.

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In operation, the apparatus 100 cools just-molded preforms 232 in parallel with the molding of new preforms in mold 217. For example, after a just-molded batch of preforms 232 has cooled sufficiently within the mold 217 for handling, the mold halves 214 and 216 may separate. The robot 222 may move take-off device 228 (downwardly in FIG. 2) between the mold halves 214 and 216 and position
10 the device 228 for removal of the preforms from the mold cores 220 (this positioning not being expressly shown in FIG. 2). The take-off device 228 may then receive the preforms 232, one preform 232 per receptacle 230, and may remove them from the mold. The robot 222 may then move the take-off device 228 (upwardly in FIG. 2), along with the preforms 232, to a position that is opposite the apparatus 100, as shown in FIG. 2. The moving platen 204 may then be moved towards the fixed
15 platen 202 for the purpose of closing the mold 217 for molding the next batch of preforms.

Because the apparatus 100 is attached to the moving platen 204 via support 140, movement of the moving platen 204 towards the fixed platen 202 causes the apparatus 100 to similarly move towards the take-off device 228. When the mold halves 214 and 216 fully close (not shown in FIG. 2), the
20 conditioning pins 104 of apparatus 100 will be received within respective preforms 232 that are held by the receptacles of take-off device 228. Based on an adjustment made earlier using adjustment mechanism 108, the exposed length E of the conditioning pins 104 will be suitable for positioning the outlets 103 of the pins in a desired or target position with respect to the respective molded articles to be cooled when the mold 217 is closed. This is illustrated, for a single preform 232, in FIG. 3.

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FIG. 3 illustrates the position of an exemplary conditioning pin 104 relative to an exemplary preform 232 being held, during post-mold cooling, by a receptacle 230 of take-off device 228. As shown in FIG. 3, the exposed length E of the conditioning pin 104 is such that that the outlet 103 at the distal end 105 of the pin is positioned proximately to a targeted area of the molded article, which in this
30 example is an interior surface of the closed end 233 of the preform 232, when the mold 217 is in the closed position. This positioning may provide a desired conditioning effect, e.g. may expedite cooling of the targeted area of the molded article and/or may limit crystallization of molding material in targeted area of the molded article.

35 Air flow during cooling of the preform 232 is represented in FIG. 3 using arrows denoted A. Air under positive pressure within the plenum 110 flows into a proximal end 107 of the conditioning pin

104. The air may then flow through the length of the conditioning pin 104 (rightwardly in FIG. 3) until it exits or is blown from outlet 103. This exiting air is blown against (i.e. contacts) the targeted area, which in this case is the interior surface of the closed end of the preform 232, and may be thereby redirected so as to flow in the opposite direction (leftwardly in FIG. 3) through the annular space between the conditioning pin 104 and the interior surface of the preform 232. The air may subsequently exit the open neck 235 of the preform 232 into the surrounding cup 117. The cup 117 may in turn cause the exiting air to be redirected to flow about an exterior of the open neck 235 of the preform 232 (rightwardly in FIG. 3). The cup 117 may thus facilitate or enhance cooling of the open neck 235 of the preform.

To the extent that it becomes necessary to use the molding system 200 to mold articles of a different type or form factor, such as a longer preform, then the apparatus 100 may be easily reconfigured for conditioning such articles. Initially, operation of the molding system 200 (FIG. 2) may be suspended. With the system 200 offline, the mold halves 214 and 216 may be swapped out for new mold halves suitable for molding the longer preforms. In view of the increased length of the preform to be molded, the currently exposed length E of the conditioning pins 104 may be considered too short for effectively cooling the closed ends of the longer preforms. In that case, the adjustment mechanism 108 may be adjusted, e.g. by rotating the screw that forms part of that mechanism, to decrease the separation S between the frame 106 (see FIG. 1 and 3) and the plate 102 until a target exposed length E' is attained (see FIG. 1). If the new preforms to be conditioned are shorter than the current preforms, a converse approach could be used to shorten the exposed lengths E. In this way, a target or optimal separation between a distal end 105 (or outlet 103) of each conditioning pin 104 and an interior surface of a closed end of the preforms to be molded may be maintained regardless of the length of the preforms.

In view of the adjustability of the conditioning pin lengths, the apparatus 100 may be suited for quick mold change (“QMC”) applications. For example, the amount of time required to adjust the exposed length E of the conditioning pins 104 may be less than the amount of time required to swap out a plate of non-adjustable length conditioning pins for a new plate of non-adjustable length conditioning pins of a different length, as may be required in some conventional systems. A faster tooling changeover time may reduce machine down time. Moreover, because the same apparatus 100 may be reused for different molded articles, capital expenditures may be reduced, e.g. in comparison to systems that use different plates of conditioning pins for each type or form factor of article that is to be molded.

It will be appreciated that, in embodiments having cups such as cups 117 of FIGS. 1 and 3, a distance between a distal end of a conditioning pin and its respective cup may be adjusted by extending or retracting the conditioning pin relative to the cup. This permits the distal end of the conditioning pin to be positioned proximately to the closed end of the preform, e.g. for effective cooling thereof, while
5 maintaining the cup in a suitable position (as described above) for simultaneously enhancing cooling the open neck area of the preform, regardless of the length of the preform. In contrast, a conventional pin of fixed length having a cup fixedly attached at or about its base may not provide such a benefit.

In some embodiments, adjustment of the exposed length E of the conditioning pins 104 by way of the
10 adjustment mechanism 108 may be manually actuated. In other embodiments, adjustment of the exposed length E of the conditioning pins 104 may be wholly or partially automated using an actuator responsive to electronic operator control. For example, referring to FIG. 4, a schematic representation of an automated control system 400 that may be used to control the apparatus 100 of
15 FIG. 1 is shown. The control system 400 may form part of the molding system 200 for example. As illustrated, the exemplary system 400 comprises a controller 402 operably connected to each of an actuator 404 and a human-machine interface (HMI) 406. FIG. 4 adopts a convention whereby communication between components (e.g. by way of electronic signals) is illustrated using solid
20 arrows, while mechanical control or physical linkage between components is illustrated using a dashed arrow.

Controller 402 may be a controller associated with a molding system, such as the exemplary injection
molding system 200 of FIG. 2, that has been configured to execute controller-executable instructions for facilitating automated adjustment of the exposed length E of conditioning pins 104 using the
25 apparatus 100 as described herein. The instructions may be loaded by the controller 402, e.g. into a volatile controller memory (not expressly illustrated), from a non-transitory machine-readable or computer-readable medium 408, such as an optical disk or magnetic storage medium for example, or may be stored in a non-volatile non-transitory memory within the controller 402. In some
30 embodiments, the controller 402 may comprise a plurality of controllers working in unison. For example, one controller (e.g. a Siemens™ motor controller) may apply control algorithms to calculate power requirements for actuating physical machine components. This controller may in turn
be connected to a separate motor controller that receives the calculated power requirements and converts them to a voltage output for an actuator (e.g. actuator 404) that effects the movement.

The HMI 406 may comprise a display (e.g. an LCD screen or otherwise) and a user input mechanism
35 (e.g. a touchscreen, keyboard, pointing device or otherwise) for receiving operator input. In some

embodiments, the HMI may be executed by a separate or standalone device having at least one processor, e.g. a Windows™-based PC.

5 The actuator 404 may be a hydraulic actuator, pneumatic actuator, a motor (e.g. a DC motor, stepper motor, linear motor, piezo-actuator), or otherwise. The actuator may be physically or mechanically coupled to the adjustment mechanism 108, e.g. by way of a mechanical linkage. Alternatively, the actuator may be electromagnetically coupled to the adjustment mechanism 108.

10 Operation 500 of the controller 402 for adjusting the exposed length of the conditioning pins 104 is illustrated in FIG. 5. The operation 500 may be governed, at least in part, by the instructions loaded from the medium 408 (FIG. 4).

15 In 502 (FIG. 5), a current length E of the conditioning pins 104 is determined. In some embodiments, this may be done by reading a value stored in controller memory or by sensing the current length E using a sensor for example.

20 In 504, a target length E' for the conditioning pins 104 is determined. In some embodiments, the target length may be determined on the basis of operator input, from a user interface, such as user interface 600 of FIG. 6 (described below).

In 506, a length adjustment (denoted ΔE) to be made to the exposed length of the conditioning pins 104 is automatically computed. For example, the controller 402 may automatically compute the length adjustment by computing a difference between a current length E and a target length E'.

25 In 508, a signal is output for causing the actuator to make the length adjustment, i.e. to cause the length of the conditioning pins 104 to be adjusted to the target length E'. The signal may be based on the computed difference. In some embodiments, the controller 402 may use a feedback loop comprising a position sensor to periodically or continuously monitor the current length E during adjustment of 508, so that it will be known when the target length E' has been attained.

30 Referring to FIG. 6, an exemplary user interface (UI) 600 that may be displayed on a display of the HMI 406 is illustrated. The UI includes an indicator 602 of a current length E of the conditioning pins 104.

35 The UI also includes a user interface control 604 for allowing an operator to input or otherwise specify a target length E' of the conditioning pins 104 for the article to be produced by the molding

system 200 (e.g. for the purpose of operation 504, described above). The exemplary user interface control 604 illustrated in FIG. 6 is an editable text field. However, the user interface control could alternatively be one that provides a predetermined set of selectable options, such as a pull-down menu, a set of radio buttons, or the like, wherein each selectable option represents a different target length E'.
5

In some embodiments, the user interface control 604 may not require the operator to specify or select a target length E' as such. Rather, in some embodiments, the operator may only be required to input an indicator (e.g. unique part identifier or similar) of the article to be molded. For example, a user interface control, such as a menu (not depicted), may be presented in UI 600 instead of text field 604. The menu may present a list selectable options, each representing a different part (e.g. a different type or form factor or molded article) that the system 200 is capable of molding. When an operator selects one of the options using a user input mechanism, an indicator of the corresponding article may be generated and provided to the controller 402. The controller 402 may then automatically determine a target length E' for the conditioning pins, e.g. by using the indicator to index into a database table (or any other suitable data structure). In other words, once the article to be molded has been identified using UI control 604, the controller 402 may automatically map the article to a target length E' of the conditioning pins for conditioning that article. This may relieve an operator from the burden of having to know or manually look up the target length E' for each type of molded article that the system 200 is capable of molding.
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The UI 600 may further include user interface control 606, such as a button, for triggering the computed adjustment ΔE . Another user interface control 608, which may be another button, may permit the user interface 600 to be exited when adjustment is complete. Alternatively, the adjustment may be determined based on data from a network database or online source.
25

Further, in some embodiments, the operator may not even be required to use a UI control such as control 504 to input a target length E' or to identify the article to be molded. Instead, mold components that are replaced within the molding system 200 during retooling may be encoded (e.g. using a Mold ID tag) with such information. For example, it is possible that either one or both of the mold halves 214 and 216 may be encoded with an indicator of a form factor, a type, or a dimension of the article to be molded, or an indication of a target length E' of a conditioning pin to be used for conditioning the article. The encoding could be achieved in any number of ways, e.g. using machine-detectable features such as patterns of magnets (which could be sensed using Hall effect sensors), machine-detectable physical features such as holes or depressions, or the like. Such an indicator may be automatically sensed or read, during or after mold retooling, by the sensor forming part of the
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control system 400. Thereafter, the information may be used to automatically adjust the length of the pins, as described above. In such embodiments, there may be no need to present any UI similar to the UI 600 of FIG. 6.

5 Various alternative embodiments are possible.

For example, although the preceding description describes an apparatus 100 for cooling preforms, alternative embodiments of the apparatus may be used for cooling other types of molded articles. The molded articles are not necessarily open containers and may have various shapes. The articles may
10 include, without limitation, closures, thin walled containers, and medical parts (e.g. vials, test tubes, and the like).

In the preceding description, the type of conditioning performed by the apparatus 100 is cooling. It will be appreciated that alternative embodiments may perform other types of conditioning upon
15 molded articles.

Some embodiments of the conditioning apparatus may not incorporate a plenum. For example, tubes or lines may be used to supply a conditioning fluid such as a pressurized gas to the proximal ends of the conditioning pins.
20

Although the foregoing embodiment describes use of cups 117 for conditioning an open neck area of molded articles, cups are not necessarily present in all embodiments. For example, cups may be omitted if the neck area of the molded article does not require enhanced conditioning. Alternatively, cups may be omitted if the molded article to be conditioned lacks an open neck area (e.g. when the
25 articles are not containers).

In the apparatus 100 described above, each conditioning pin 104 is used to condition a respective molded article 232. It is possible that, in some embodiments, a single molded article may be conditioned using multiple conditioning pins.
30

In the apparatus 100, each of the conditioning pins 104 is described and illustrated as an elongate rigid tube with a central passage for air and a single outlet at its distal end. This is but one example of a conditioning pin. Alternative conditioning pins may have multiple passages, and/or multiple outlets, for conditioning fluid. The outlet(s) may face in any direction, such as longitudinally,
35 radially, or both. The outlet(s) may have various shapes. The distal end of a conditioning pin may be open or closed.

In the apparatus 100 described above, the adjustment mechanism 108 comprises a screw with threaded and unthreaded portions. It will be appreciated that various alternative adjustment mechanisms could be used in place of the mechanism 108 for adjusting the exposed length E of the conditioning pins 104. For example, in an alternative embodiment, the threaded and unthreaded portions of an alternative adjustment mechanism could be reversed, i.e. the threaded portion of the screw may be threaded into a threaded opening in the frame 106, and the unthreaded portion may be received within a hole, and longitudinally fixed with respect to, the plate 102. Alternatively, the adjustment mechanism may comprise, or may work in conjunction with, a collet mounted in the plate 102 through which the pins mounted to the frame 106 can slide. The collet may be threaded to support side-mounted set screws that may lock the pins in a fixed location. The pins can be scribed to ensure that all the pins will be “locked-down” at the same position to ensure parallelism to the plate 102.

Alternative forms of adjustment mechanism may include: a multi-bar linkage (slider crank, parallelogram, or the like); a linear motor/actuator mechanism (using magnetic forces); and a rotary motor with a ball screw or planetary roller screw, cam or wedge actuation.

In the above description, the exposed length E of a conditioning pin is measured as the distance between the collar 114 and the distal end 105 of the conditioning pin. It will be appreciated that the exposed length E could be measured between other reference points, such as between the distal end 105 of the conditioning pin 104 and the plate 102, or between the distal end 105 of the conditioning pin 104 and a reference point on the cup 117 (if present) for example.

Anywhere in this document, when it is stated that a first component is moved relative to a second component, this should be understood to include the following scenarios: the first component being moved while the second remains stationary; the second component being moved while the first remains stationary; or both components being moved but at different rates or in different directions.

In an embodiment comprising cups, it will be appreciated that direct or indirect attachment of the cups to a plate, such as plate 102, is but one way of achieving a fixed relation between cups. In some embodiments, there may be no plate 102 or support structure per se. For example, it is possible for a plurality of cups to be simply be welded together.

It is possible that, in some embodiments, the conditioning apparatus may move the conditioning pins relative to the molded articles as the molded articles are being conditioned. The exposed length E can

be made to vary during the molding cycle, e.g. by decoupling the plenum 110 from movable platen 204 (e.g. by removing the support 140) and via suitable actuation of the articles relative to the pins. When the exposed length E is variable, cooling may be performed according to a profile that may be molded part-specific. For example, certain areas (e.g. areas with more molding material such as thicker walls) may be cooled for a longer period of time than other areas (e.g. areas with less molding material such as thinner walls). Each conditioning pin may be designed such that the air exits through its sidewalls instead of, or in addition to, its distal end, causing impingement flow on internal walls of the associated preform. Forward or backward actuation of the pins relative to the molded articles may cause cooling to be more effective in regions of the preform body that are thicker than others, whether at or near the closed end of the articles or elsewhere, or may allow fewer openings to be used in the conditioning pin (e.g. to maximize pressure differential and an associated speed of conditioning fluid flowing from the conditioning pin).

Other modifications may be made without deviating from the scope of the following claims.

Various embodiments having been thus described in detail by way of example, it will be apparent to those skilled in the art that variations and modifications may be made without departing from the invention. The invention includes all such variations and modifications as fall within the scope of the appended claims. As such, the described non-limiting embodiment(s) ought to be considered to be merely illustrative of some of the more prominent features and applications. Other beneficial results can be realized by applying the non-limiting embodiments in a different manner or modifying them in ways known to those familiar with the art. This includes the mixing and matching of features, elements and/or functions between various non-limiting embodiment(s) is expressly contemplated herein so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as appropriate, unless described otherwise, above. Although the description is made for particular arrangements and methods, the intent and concept thereof may be suitable and applicable to other arrangements and applications.

WHAT IS CLAIMED IS:

1. An apparatus (100) for conditioning molded articles (232) that have been removed from a mold (217), the apparatus comprising:
 - a plate (102);
 - a plurality of conditioning pins (104) extending through the plate, each of the conditioning pins for applying a conditioning fluid to a surface of a molded article; and
 - an adjustment mechanism (108) for adjusting an exposed length of the plurality of conditioning pins by way of relative movement between the conditioning pins and the plate.
2. The apparatus of claim 1 wherein each of the conditioning pins is attached to a frame (106) and wherein the adjusting comprises moving the frame relative to the plate.
3. The apparatus of claim 2 further comprising a plenum (110), the plenum containing the conditioning fluid under pressure, wherein the frame is situated within the plenum, and wherein the plate is situated outside of the plenum and in fixed relation to an external face of the plenum.
4. The apparatus of claim 2 wherein the adjustment mechanism comprises a screw having a threaded portion (120), the threaded portion being received within a threaded hole (124) in one of the plate and the frame, the screw further comprising an unthreaded portion (122) that is rotatably received by, and longitudinally fixed with respect to, the other of the plate and the frame.
5. The apparatus of claim 1 further comprising a plurality of cups (117) mounted on one side of the plate and in fixed relation to the plate, with an open end of each cup facing outwardly from the plate, each of the cups having a base (119) with an opening (121) therein and a respective one of the conditioning pins extending through the opening into the cup.
6. The apparatus of claim 1 wherein the conditioning is cooling and wherein the conditioning fluid is pressurized air.
7. The apparatus of claim 1 wherein the molded articles comprise preforms and wherein each of the conditioning pins has at least one outlet (103) for directing the conditioning fluid onto an interior surface of a closed end (233) the preform.

8. The apparatus of claim 1, further comprising an actuator (404) for actuating the adjustment mechanism responsive to a control signal.
9. The apparatus of claim 1, wherein each of the conditioning pins has at least one outlet at or near a distal end (105) of the conditioning pin.
10. An apparatus (100) for conditioning a plurality of articles (232) removed from a mold, each of the articles being a molded container having an open neck (235), the apparatus comprising:
 - a plurality of cups (117) oriented in the same direction and being in fixed relation to one another, each of the cups being sized for encompassing the open neck (235) of a respective one of the molded containers (232), each of the cups further having a base (119) with an opening (121) therethrough;
 - a plurality of conditioning pins (104) in fixed relation to one another, each of the conditioning pins being configured for applying a conditioning fluid to an interior of a respective one of the molded containers, each of the conditioning pins extending through the opening in the base of a respective one of the cups and into the cup; and
 - an adjustment mechanism (108) for moving the plurality of conditioning pins relative to the plurality of cups to adjust a distance between a distal end of each conditioning pin and the respective cup,
 - wherein each cup is configured for causing the conditioning fluid exiting the interior of the respective one of the molded containers to be redirected to flow about an exterior of the open neck.
11. The apparatus of claim 10 further comprising a plate (102), wherein each of the cups is fixedly mounted, directly or indirectly, to the plate.
12. The apparatus of claim 10 wherein the molded containers are preforms and wherein each of the conditioning pins has at least one outlet (103) for applying the conditioning fluid to the interior of a respective one of the preforms.
13. A non-transitory computer-readable medium (408) storing instructions that, when executed by a controller (402) associated with a post-mold article conditioning apparatus (100) having a plurality of adjustable-length conditioning pins (104), cause the controller to:
 - determine (504) a target length (E') of the adjustable-length conditioning pins;

based on the determined target length of the adjustable-length conditioning pins, automatically compute (506) an adjustment (ΔE) to be made to the adjustable-length conditioning pins for attaining the target length; and

output a signal for causing an actuator (404) to effect the adjustment to the adjustable-length conditioning pins.

14. The non-transitory computer-readable medium of claim 13 wherein the controller has an associated human-machine interface (406) and wherein the determining comprises inputting, via the human-machine interface, an indication of the target length of the adjustable-length conditioning pins.
15. The non-transitory computer-readable medium of claim 13 wherein the instructions further cause the controller to input, via a human-machine interface (406) associated with the controller, an article identifier uniquely identifying an article to be conditioned by the post-mold article conditioning apparatus, and wherein the determining of the target length of the adjustable-length conditioning pins comprises mapping the article identifier to the target length of the adjustable-length conditioning pins.
16. The non-transitory computer-readable medium of claim 15 wherein the inputting of the article identifier comprises receiving, via the human-machine interface, a selection of one of a plurality of selectable options displayed in a user-interface control, each selectable option being associated with a unique article identifier.
17. The non-transitory computer-readable medium of claim 13 wherein the automatically computing of the adjustment to be made to the adjustable-length conditioning pins comprises:
 - determining (502) a current length (E) of the adjustable-length conditioning pins; and
 - computing a difference between a current length of the adjustable-length conditioning pins and the target length of the adjustable-length conditioning pins.
18. The non-transitory computer-readable medium of claim 13 wherein the instructions further cause the controller to input, via a sensor associated with the controller, an indicator of a type, a form factor, or a dimension of an article to be molded, and wherein the determining of the target length of the adjustable-length conditioning pins comprises mapping the indicator to the target length of the adjustable-length conditioning pins.

19. The non-transitory computer-readable medium of claim 18 wherein the indicator that is input via the sensor is encoded on a mold component that is specific to the article to be molded.

20. The non-transitory computer-readable medium of claim 13 wherein the instructions further cause the controller to input, via a sensor associated with the controller, an indicator of the target length of the adjustable-length conditioning pins to be used for conditioning the article.

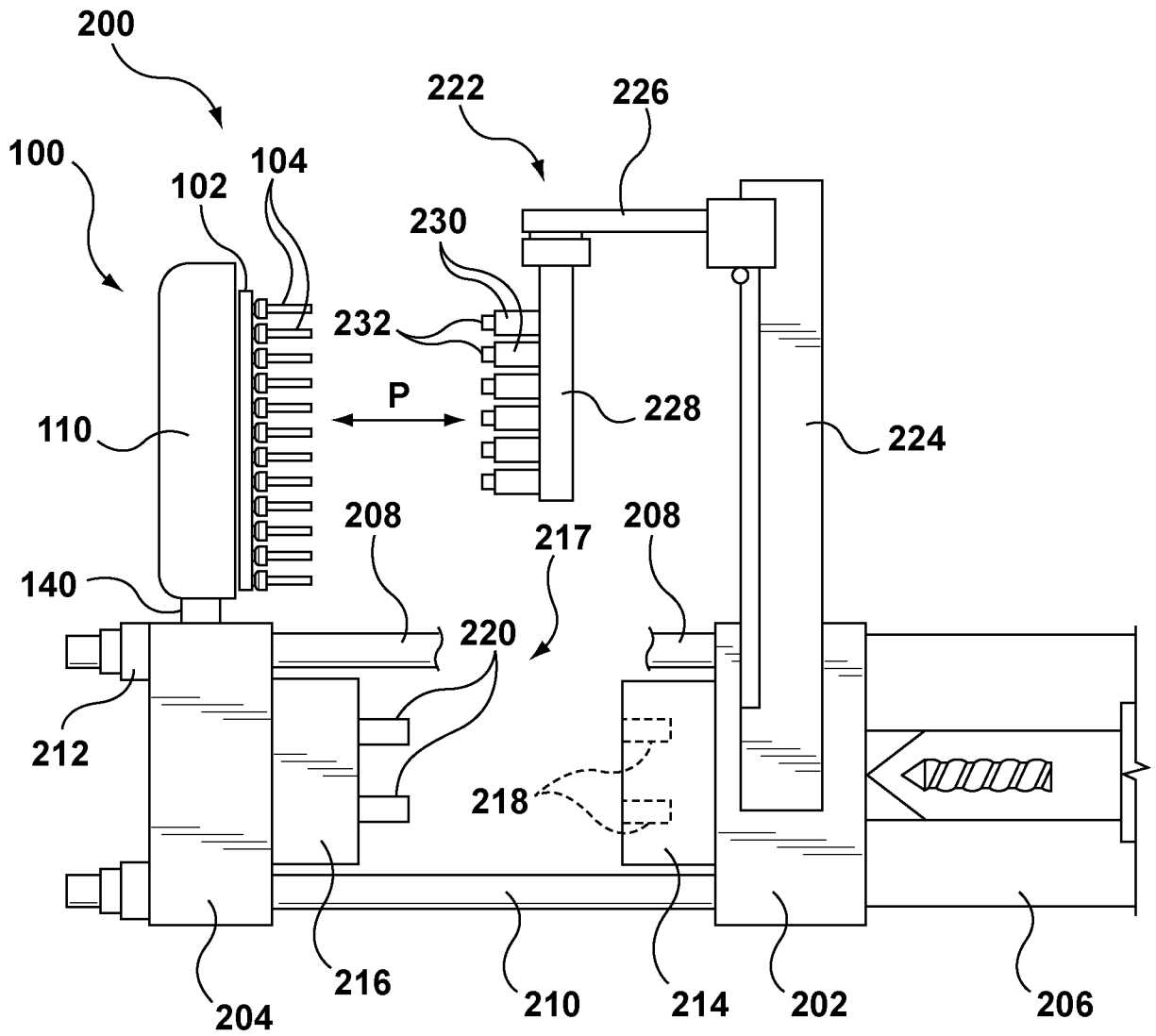
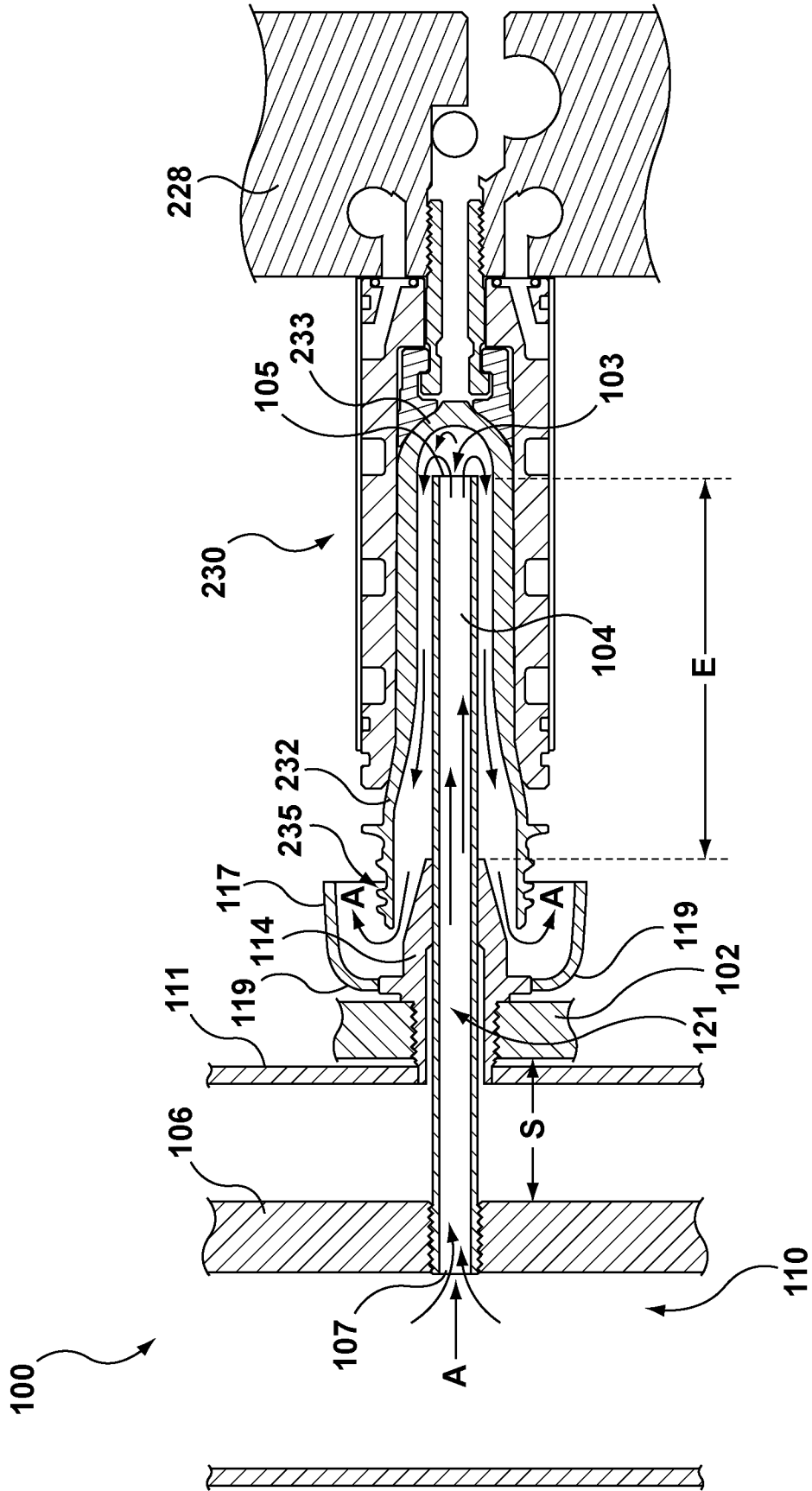


FIG. 2



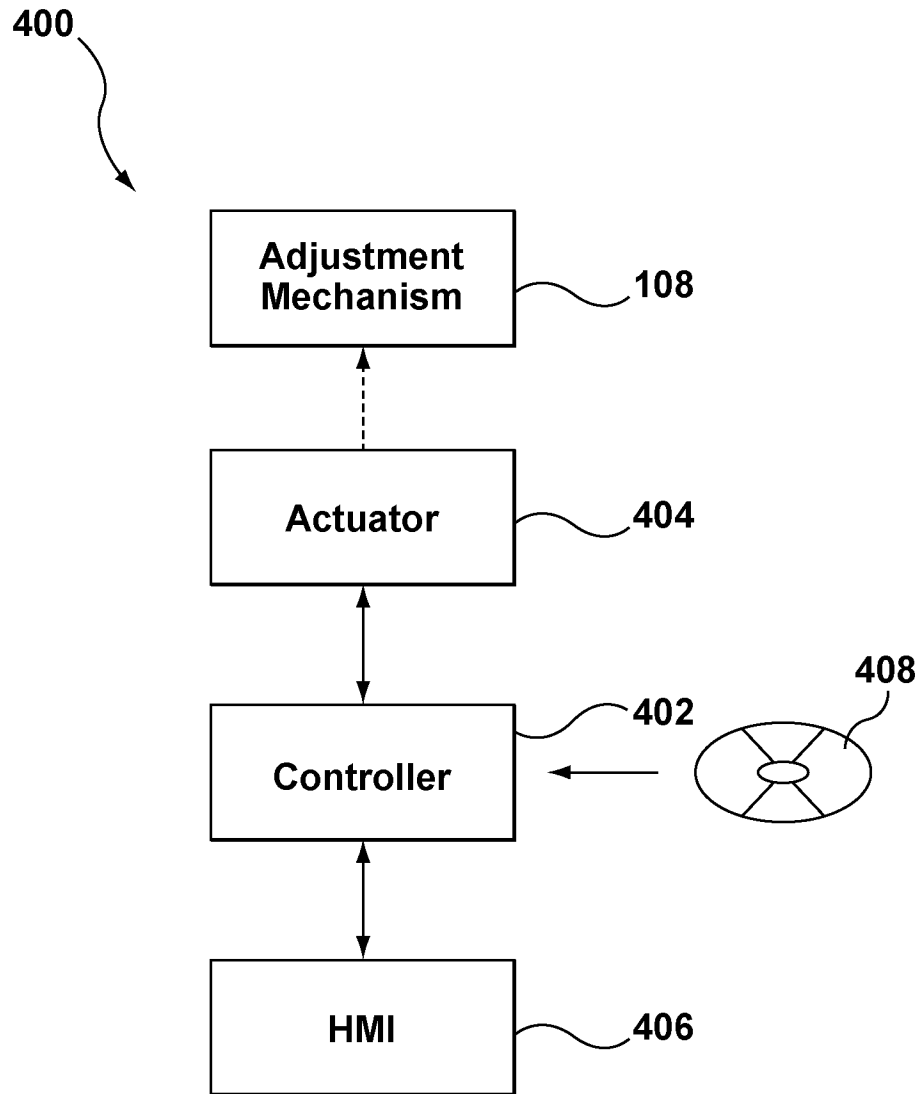
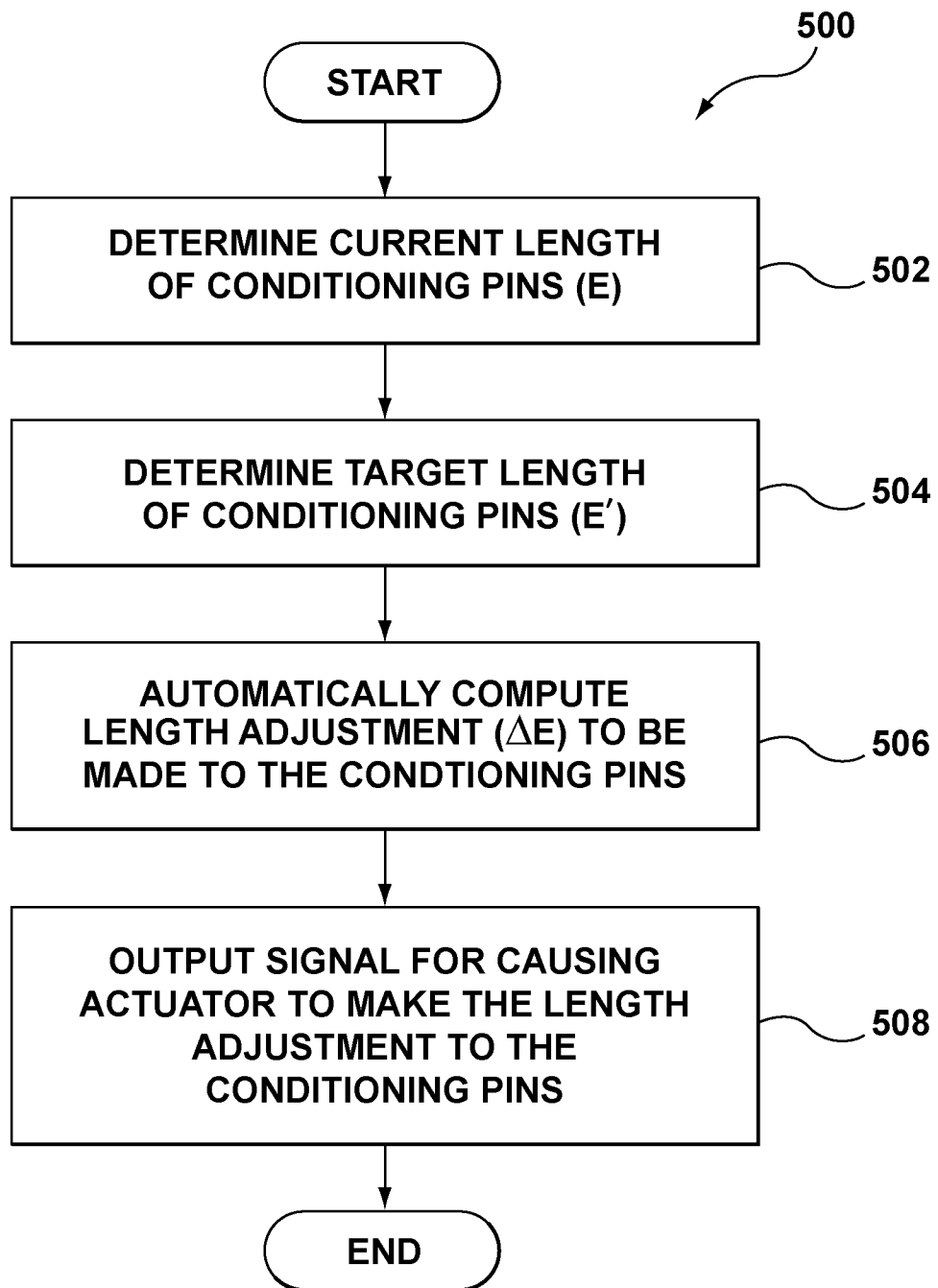


FIG. 4

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**FIG. 5**

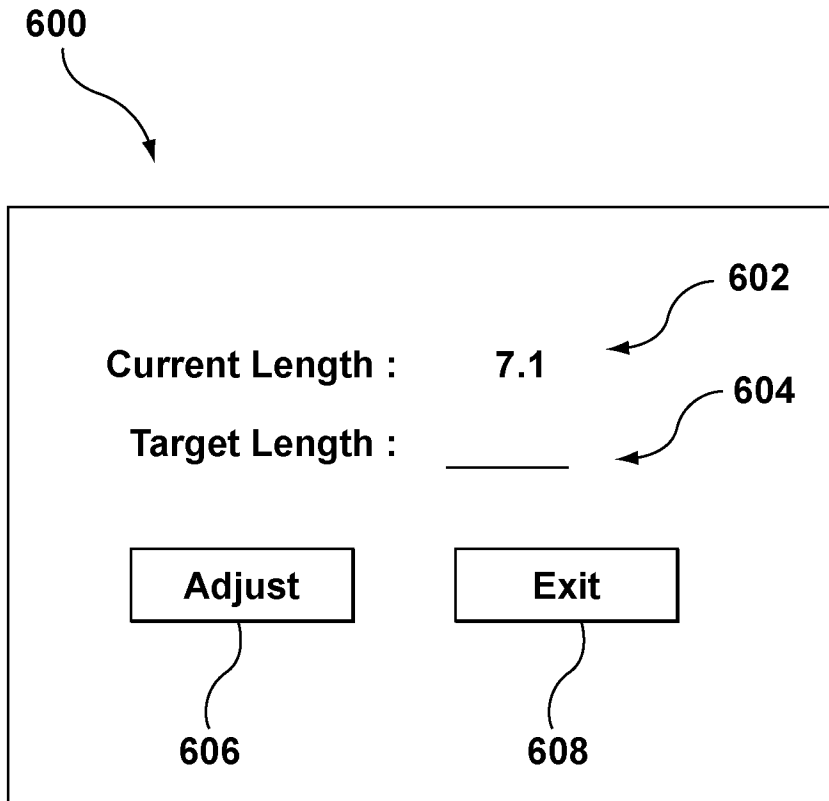


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2015/050155

A. CLASSIFICATION OF SUBJECT MATTER
 IPC: **B29C 45/40** (2006.01), **B29C 45/83** (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 45/40 (2006.01), **B29C 45/83** (2006.01) **B29C 45/43** (2006.01), **B29C 45/72** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
 Questel-Orbit, Internet

Keywords: cooling, pins, adjustable, length, post mold, preform+, cooling, conditioning device,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO2013026145A1, (SCHAD, R.D. et al) 28 February 2013 (28-02-2013) * paragraph [0087], Figure 11 *	1-20
A	CA2326449A1, (BRAND, T. et al) 07 October 1999 (07-10-1999) * the whole document *	1-20

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search
 15 April 2015 (10-13-2015)

Date of mailing of the international search report
 18 June 2015 (18-06-2015)

Name and mailing address of the ISA/CA
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2015/050155

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
WO2013026145A1	28 February 2013 (28-02-2013)	WO2013026145A1 WO2013026144A1	28 February 2013 (28-02-2013) 28 February 2013 (28-02-2013)
CA2326449A1	07 October 1999 (07-10-1999)	CA2326449A1 CA2326449C AT226135T AT281295T AU746598B2 AU746598C AU2040602A AU8575698A BR9815798A CA2430598A1 CH693171A5 CN1294546A CN1231340C CN1375390A CN1275759C CN1592678A CN1817606A CN1817606B DE69808728D1 DE69808728T2 DE69808728T3 DE69827418D1 DE69827418T2 DK0947304T3 DK1260339T3 EP0947304A2 EP0947304A3 EP0947304B1 EP0947304B2 EP1260339A2 EP1260339A3 EP1260339B1 EP1345752A2 ES2185093T3 ES2230434T3 HK1036031A1 HK1052156A1 IL138727D0 IL138727A IL162684A IL162684D0 JP2002509817A JP3665568B2 JP2005067206A JP4358715B2 JP2004515392A KR100386415B1 KR20030031514A KR20040005864A MXPA03005495A RU2189313C2 US6171541B1 US2001005063A1	07 October 1999 (07-10-1999) 02 October 2007 (02-10-2007) 15 November 2002 (15-11-2002) 15 November 2004 (15-11-2004) 02 May 2002 (02-05-2002) 08 May 2003 (08-05-2003) 01 July 2002 (01-07-2002) 18 October 1999 (18-10-1999) 23 July 2002 (23-07-2002) 27 June 2002 (27-06-2002) 27 March 2003 (27-03-2003) 09 May 2001 (09-05-2001) 14 December 2005 (14-12-2005) 23 October 2002 (23-10-2002) 20 September 2006 (20-09-2006) 09 March 2005 (09-03-2005) 16 August 2006 (16-08-2006) 09 February 2011 (09-02-2011) 21 November 2002 (21-11-2002) 12 June 2003 (12-06-2003) 26 April 2012 (26-04-2012) 09 December 2004 (09-12-2004) 02 March 2006 (02-03-2006) 17 February 2003 (17-02-2003) 14 March 2005 (14-03-2005) 06 October 1999 (06-10-1999) 09 August 2000 (09-08-2000) 16 October 2002 (16-10-2002) 07 December 2011 (07-12-2011) 27 November 2002 (27-11-2002) 04 December 2002 (04-12-2002) 03 November 2004 (03-11-2004) 24 September 2003 (24-09-2003) 16 April 2003 (16-04-2003) 01 May 2005 (01-05-2005) 16 June 2006 (16-06-2006) 09 February 2007 (09-02-2007) 31 October 2001 (31-10-2001) 17 May 2005 (17-05-2005) 20 November 2005 (20-11-2005) 20 November 2005 (20-11-2005) 02 April 2002 (02-04-2002) 29 June 2005 (29-06-2005) 17 March 2005 (17-03-2005) 04 November 2009 (04-11-2009) 27 May 2004 (27-05-2004) 02 June 2003 (02-06-2003) 21 April 2003 (21-04-2003) 16 January 2004 (16-01-2004) 14 May 2004 (14-05-2004) 20 September 2002 (20-09-2002) 09 January 2001 (09-01-2001) 28 June 2001 (28-06-2001)

INTERNATIONAL SEARCH REPORT

International application No.
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(cont'd)

US6461556B2	08 October 2002 (08-10-2002)
US6475415B1	05 November 2002 (05-11-2002)
US6475422B1	05 November 2002 (05-11-2002)
US6488878B1	03 December 2002 (03-12-2002)
US2002074687A1	20 June 2002 (20-06-2002)
US6558598B2	06 May 2003 (06-05-2003)
US2003108638A1	12 June 2003 (12-06-2003)
US6957954B2	25 October 2005 (25-10-2005)
WO0249820A2	27 June 2002 (27-06-2002)
WO0249820A3	31 October 2002 (31-10-2002)
WO9950039A1	07 October 1999 (07-10-1999)
