

(43) International Publication Date
12 April 2012 (12.04.2012)(10) International Publication Number
WO 2012/045170 A1

- (51) **International Patent Classification:**
B29C 45/43 (2006.01) *B29C 45/26* (2006.01)
- (21) **International Application Number:**
PCT/CA2011/050555
- (22) **International Filing Date:**
13 September 2011 (13.09.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/390,764 7 October 2010 (07.10.2010) US
- (71) **Applicant (for all designated States except US):** HUSKY INJECTION MOLDING SYSTEMS LTD. [CA/CA]; 500 Queen Street South, Bolton, Ontario L7E 5S5 (CA).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** GLAESENER, Pierre [LU/LU]; 40, rue de Mersch, L-7780 Bissen (LU).
- (74) **Agent:** HUSKY INTELLECTUAL PROPERTY SERVICES; c/o Husky Injection Molding Systems Ltd., 500 Queen Street South, Bolton, Ontario L7E 5S5 (CA).
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

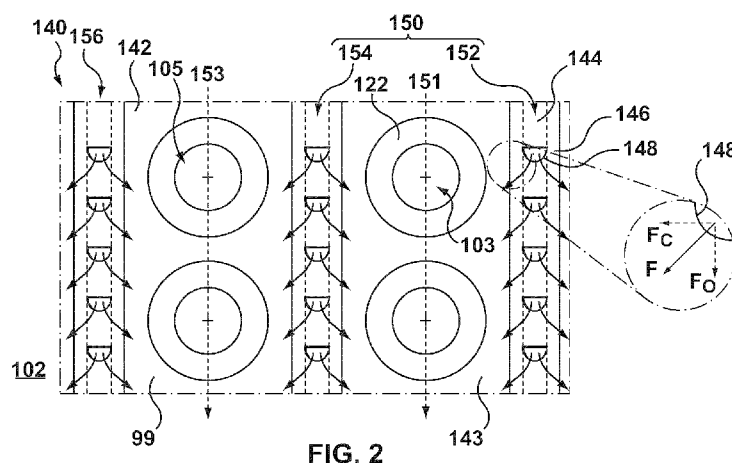
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, QA, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

- with international search report (Art. 21(3))

(54) **Title:** INJECTION MOLD HAVING AN IN-MOLD MOLDED ARTICLE CONVEYANCE DEVICE**FIG. 2**

(57) **Abstract:** Disclosed herein are an injection mold (100) having an in-mold molded article conveyance device (150) associated therewith and a related process for injection molding of a molded article. The injection mold 100 includes a first mold portion (102) and a second mold portion (104) that is configured to define, in use, a molding cavity (101) therebetween within which a molded article (2) is moldable. The in-mold molded article conveyance device (150) includes a first column of air nozzles (152) and a second column of air nozzles (154) that bracket the molding cavity (101) along an interface (99) between the first mold portion (102) and the second mold portion (104). Furthermore, the first column of air nozzles (152) and the second column of air nozzles (154) are oriented to generate, in use, an air corridor (151) therebetween within which the molded article (2) is entrainable, upon ejection from the molding cavity (101), for accelerated conveyance towards a perimeter (143) of the injection mold (100).

INJECTION MOLD HAVING AN IN-MOLD MOLDED ARTICLE CONVEYANCE DEVICE

TECHNICAL FIELD

5

Embodiments of the present invention generally relate to the molding arts and more particularly to an in-mold molded article conveyance device for use with an injection mold.

BACKGROUND OF THE INVENTION

10

US patent application 2007/0287119 to Lyons, Freddy, published on December 13, 2007, discloses an air conveyor for handling workpieces in a food grade environment has a cylindrical pipe with an elongated slot that extends along an axial length of the pipe. A track is snap fit in the elongated slot and has a base for supporting the workpieces. The base has air
15 vents that provide directional airflow for pushing the workpieces along an axial length of the track on a cushion of air. A movable hanger assembly supports the pipe from above and captures the workpieces in the track.

20

US patent 4,151,236 to RYDER, Leonard, published on April 24, 1979, discloses an improvement in the method of operating a molding apparatus for use in molding plastic and other materials is provided. The inner mold surfaces of the apparatus are flooded, during operation, with a dehumidified gas such as dry air to minimize condensation of moisture onto these surfaces. This dry air forms a field in the area of the mold surfaces to keep out the normally moist ambient air. The field is exhausted and recirculated to the supply source where
25 it is regenerated and returned to the area of the mold surfaces. In this way, a continuous concentration of dry air is maintained in contact with the mold surfaces. One or more dry air curtains are also established around the dry air field to prohibit moist air from entering the field. The air curtain may be established from the same supply source as the dry field or from a separate source and may also be recirculated. A cloud of dry gas may be emitted outside of
30 the air curtains to further inhibit the flow of moist ambient air to the mold surfaces.

35

US patent 4,976,900 to TSUTSUMI, Shigeru, published on December 11, 1990, discloses a method and an apparatus for injecting a steam into a mold in an injection molding machine by injecting a desired stream toward the opening of the metal mold including a gate and cavities
in connection with the opening and closing operation of the metal mold thereby intending the

cooling solidification of the molten resin on the gate portion and simultaneously intending removal of dewing and an oily matter on the surface of the metal mold.

US patent 5,609,305 to WEBB, Richard, published on March 11, 1997, discloses an air flow apparatus for providing a continuous curtain of air or other fluid includes a body member defining a first elongate plenum chamber, at least one inlet opening through which the first plenum chamber receives compressed air and an outlet opening for discharging air from the body member. The apparatus may also include a second plenum chamber (which communicates with the outlet opening) and at least one passageway connecting the first and second plenum chambers. The body member discharges the air without deflecting it towards one of its outer surfaces.

US patent 7,223,060 to WEIDENMUELLER, Ralf, published on May 29, 2007, discloses a device for simultaneously conveying and regulating the temperature of shaped parts, comprising a conveying device, which is suited for advancing objects, and at least one blower by means of which the objects can be subjected to the action of an air flow while being advanced. The conveying device is characterized in that it is formed by a closed channel whose clearance height approximately corresponds to the height of an individual shaped part, whose clearance width at least along a portion of its length is greater by a multiple than the width of an individual shaped part, in whose base plate a multitude of air inlet openings are arranged with a blowing direction oriented in the longitudinal direction of the channel and diagonal to the surface, and in whose cover plate, which is situated opposite the base plate, a multitude of air inlet openings are placed. The air flow produced by the blower can be introduced into the channel via the air inlet openings.

SUMMARY OF THE INVENTION

According to an aspect disclosed herein, there is provided a molding apparatus that includes an in-mold molded article conveyance device for use with an injection mold (100). The in-mold molded article conveyance device includes a first column of air nozzles and a second column of air nozzles with which to bracket, in use, a molding cavity along an interface between a first mold portion and a second mold portion of the injection mold. Furthermore, the first column of air nozzles and the second column of air nozzles are oriented to generate, in use, an air corridor therebetween within which the molded article is entrainable, upon

ejection from the molding cavity, for accelerated conveyance towards a perimeter of the injection mold.

According to another aspect disclosed herein, there is provided a process for injection molding a molded article. The process starts with closing an injection mold to define a molding cavity between a first mold portion and a second mold portion. Next, molding a molded article within the molding cavity with injection and solidification of molding material therein. Followed by opening of the injection mold a distance that is sufficient to permit the molded article to move along an interface between the first mold portion and the second mold portion once ejected from the molding cavity. Then, ejecting the molded article from the molding cavity. The process then ends after directing air through a first column of air nozzles and a second column of air nozzles of an in-mold molded article conveyance device that bracket the molding cavity along the interface to form an air corridor within which the molded article is entrainable for accelerated conveyance towards a perimeter of the injection mold.

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

BRIEF DESCRIPTION OF THE DRAWINGS

The invention and its embodiments will be more fully appreciated by reference to the following detailed description of illustrative (non-limiting) embodiments in accordance with the present invention when taken in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a section view through a first non-limiting embodiment of an injection mold and of an in-mold molded article conveyance device that is associated therewith;

FIG. 2 depicts a front view of a first mold portion of the injection mold of FIG. 1 and the in-mold molded article conveyance device that is associated therewith;

FIG. 3 depicts a close-up section view through a first column of air nozzles of the in-mold molded article conveyance device of FIG. 1;

FIG. 4 depicts a close-up front view of a nozzle outlet of one of the first column of air nozzles of FIG. 3;

FIG. 5 depicts a close-up front view of another non-limiting embodiment of a nozzle outlet for use with the first column of air nozzles of the in-mold molded article conveyance device of FIG. 1;

FIG. 6 depicts a close-up front view of a further non-limiting embodiment of a nozzle outlet for use with the first column of the in-mold molded article conveyance device of FIG. 1.

FIG. 7 depicts a flow chart of a molding process according to a non-limiting embodiment.

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.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

In the detailed description that follows, numerous specific details are set forth in order to provide a thorough understanding of several non-limiting embodiments of an injection mold having an in-mold molded article conveyance device. However, it will be recognized by one of ordinary skill in the art that the injection mold may be practiced without these specific details. In other instances, well known methods, procedures, and components have not been described in detail as not to unnecessarily obscure aspects of the present invention.

With reference to FIG. 1 there is depicted a section view through a first non-limiting embodiment of an injection mold 100 and of an in-mold molded article conveyance device 150 that is associated therewith.

The injection mold 100 is shown to include a first mold portion 102 and a second mold portion 104 that are arranged in a mold-open configuration. In a mold-closed configuration (not shown) a molding cavity 101 (shown in part with reference to a cavity portion thereof) is definable therebetween within which a molded article 2 is moldable. The molded article 2 is

shown as, for example, a closure of a type for capping a bottle. That being said, the type of molded article 2 molded within the injection mold 100 is not so limited.

The molding cavity 101 is definable, in use, by a mold stack 110 that is associated with the injection mold 100. The mold stack 110 includes a first stack portion 120 and a second stack portion 110 that are associated with the first mold portion 102 and the second mold portion 104, respectively. The molding cavity 101 is openable, in use, for sake of ejection of the molded article 2 therefrom, with relative movement between the first mold portion 102 and the second mold portion 104 and thus the first stack portion 120 and the second stack portion 110 that are associated therewith.

The first mold portion 102 broadly includes a first mold shoe 140 to which the first stack portion 120 is mounted. More particularly, the first mold shoe 140 includes a plate 142 that defines a bore for receiving a cavity insert 122 of the first stack portion 120. The cavity insert 122 is configured to define the cavity portion of the molding cavity 101 as is commonly known.

Likewise, the second mold portion 104 broadly includes a second mold shoe 130 to which the second stack portion 110 is mounted. More particularly, the second mold shoe 130 is configured to receive an inner core 112, an outer core 114 and a stripper sleeve 116 of the second stack portion 110. The inner core 112 and the outer core 114 are configured to cooperate to define a core portion of the molding cavity 101 as is commonly known. The stripper sleeve 116 is configured to be movable relative to the inner core 112 and the outer core 114 in order that the molded article 2 may be stripped therefrom as is commonly known.

As previously mentioned, the injection mold 100 also includes the in-mold molded article conveyance device 150. A function of the in-mold molded article conveyance device 150 is to quickly convey the molded article 2 from the injection mold once ejected from the molding cavity 101. A technical effect of the foregoing may include improved molding efficiency due to a reduced time required to remove the molded article from the injection mold 100.

With reference to both FIGS 1 and 2, it may be appreciated that the in-mold molded article conveyance device 150 broadly includes a first column of air nozzles 152 and a second column of air nozzles 154 that are positioned to bracket (i.e. being located on either side) the molding cavity 101 along an interface 99 (i.e. substantially perpendicular to an axis along

which the first mold portion 102 and the second mold portion move relative to one another) between the first mold portion 102 and the second mold portion 104. What is meant by the interface 99 is the space between a first confronting face 141 and a second confronting face 131 of the first mold portion 102 and the second mold portion 104, respectively, when spaced apart. The first column of air nozzles 152 and the second column of air nozzles 154 may extend substantially across the entire interface 99 (i.e. across the first confronting face 141 and the second confronting face 131) as shown in FIG. 2, or across only a portion thereof.

In this combination, the first column of air nozzles 152 and the second column of air nozzles 154 are oriented to generate, in use, an air corridor 151 therebetween within which the molded article 2 is entrainable, upon ejection from the molding cavity 101, for accelerated conveyance towards a perimeter 143 (FIG. 2) of the injection mold 100. As may be appreciated from FIG. 1, the air corridor 151 is also defined between the first confronting face 141 and the second confronting face 131 of the first mold portion 102 and the second mold portion 104, respectively, when spaced apart. That is, the first confronting face 141 and the second confronting face 131 may be used to define front and back walls of the air corridor 151 when spaced apart a distance (as shown in FIG. 1) that is just sufficient to permit the molded article 2 to move along an interface 99 between the first mold portion 102 and the second mold portion 104 once ejected from the molding cavity 101.

With regards to the orientation of the first column of air nozzles 152 and the second column of air nozzles 154, or more particularly the nozzle outlets 148 thereof, with which to generate the air corridor 151, the first column of air nozzles 152 and the second column of air nozzles 154 are oriented, for example, to dispense air towards one another at an inclined angle to an axis of the air corridor 151, whereby a first component F_C of the air dispensed therefrom centers the molded article 2 in the air corridor 151, whereas a remaining component F_O of the air dispensed therefrom pushes the molded article 2 therethrough. That being said, the extent to which the first component F_C of the air is provided, if at all, may be somewhat dependent on properties of the molded article 2 (e.g. geometry, weight, etc). Moreover, it should be appreciated that it is not necessary in every case to keep the molded article 2 centered in the air corridor 151.

For optimal conveyance the first column of air nozzles 152 and the second column of air nozzles 154 may be arranged, as shown, to be substantially parallel. However, it should be appreciated that it remains possible to arrange the relative placement of the first column of air

nozzles 152 and the second column of air nozzles 154 to converge or diverge from one another.

And whereas the first column of air nozzles 152 and the second column of air nozzles 154 are shown to be substantially straight (i.e. straight portion) and substantially vertical, this need not be so in every instance. For example, the first column of air nozzles 152 and the second column of air nozzles 154 could otherwise be arranged (not shown) to include a curved portion or some other composite arrangement involving a straight portion and a curved portion. Moreover, the first column of air nozzles 152 and the second column of air nozzles 154 need not be vertical, as shown, but rather may be otherwise arranged to be inclined or substantially horizontal. The vertical arrangement is preferred only in that it takes advantage of gravity to assist in accelerating the molded article 2 along the air corridor 151, but again this is not a requirement as it is equally possible to accelerate the molded article 2 along an air corridor 151 that is arranged horizontally, or at some other inclination, more exclusively by means of the air flowing along the air corridor 151.

For sake of simplicity, the description thus far has been presented with reference to only one molding cavity 101 of the injection mold 100. It should be noted however that the injection mold 100 has been configured to include several columns of molding cavities. More particularly, and as may be appreciated with reference to FIG. 2, a front view of the first mold portion 102 reveals that the injection mold 100 includes a rectangular array of molding cavities that includes a first column of molding cavities 103, included in which is the molding cavity 101 and a second column of molding cavities 105. That being said, it should be appreciated that the layout of the molding cavities in the injection mold 100 (i.e. number and placement of the molding cavities) is not particularly limited.

Turning attention back to the present non-limiting embodiment, it may now be further appreciated that the first column of air nozzles 152 and the second column of air nozzles 154 bracket the first column of molding cavities 103 for entraining, in use, molded articles ejected therefrom. In addition, the in-mold molded article conveyance device 150 is configured to define another air corridor 153 for entraining, in use, the molded articles ejected therefrom. While not shown, the additional air corridor 153 may be defined between a wholly distinct pair of columns of air nozzles from those of the first air corridor 151. However, for sake of simplicity, the second column of air nozzles 154 may instead be oriented to further dispense air towards the second column of molding cavities 105 (i.e. in addition to dispensing air

towards the first column of molding cavities 103), and furthermore to provide a third column of air nozzles 156 with which to bracket the second column of molding cavities 103. The second column of air nozzles 154 and the third column of air nozzles 156 are configured to define the additional air corridor 153 in the same manner that the first column of air nozzles 152 and the second column of air nozzles cooperate to define the air corridor 151. That is, the second column of air nozzles 154 and the third column of air nozzles 156 are arranged to bracket the second column of molding cavities 105 along the interface 99, and wherein the second column of air nozzles 154 and the third column of air nozzles 156 are oriented to generate, in use, the air corridor 153 therebetween.

In the non-limiting embodiment depicted in the figures, the first column of air nozzles 152, the second column of air nozzles 154, and the third column of air nozzles 156 are associated, as shown, with the first mold portion 102. More specifically, the first column of air nozzles 152, the second column of air nozzles 154, and the third column of air nozzles 156 are associated with the plate 142 of the first mold shoe 140. Each of the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 include a nozzle outlet 148 that is defined in a nozzle insert 146 that is configured to overly a pressure channel 144 that is defined in the plate 142.

That being said, there are other ways that the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 may be arranged within the interface 99 between the first mold portion 102 and the second mold portion 104 such that they would not interfere with the opening and closing of the injection mold 100. For example, the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 could just have easily been associated with the second mold portion 104. As a further example, the in-mold molded article conveyance device 150 may further include additional columns of nozzles (not shown) that are associated with the second mold portion 104 with which to cooperate with the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 (that are associated with the first mold portion 102) to further define the air corridors 151 and 153. More particularly, the additional columns of nozzles may include a first column of complementary air nozzles (not shown) and a second column of complementary air nozzles (not shown) that are positioned to bracket the molding cavity 101 along the interface 99, whereby the air corridor 151 is further defined thereby. Likewise, the additional columns of nozzles may include a third column of complementary air nozzles (not shown) that along with the second column of complementary

air nozzles are positioned to bracket the molding cavity 101 along the interface 99, whereby the air corridor 153 is further defined thereby.

Turning attention back to the present non-limiting embodiment, it may now be further appreciated with reference to FIGS. 3 and 4, that the structure of the nozzle outlet 148 includes a semi-circular aperture that outlines a deflector 149 that is inclined towards an air pressure channel 144. In operation, air is deflected by the deflector 149 to fan out through the semi-circular aperture towards the columns of molding cavities that are adjacent thereto.

In an alternative non-limiting embodiment, as shown in FIG. 5, the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 may instead include the nozzle outlet 248. The nozzle outlet 248 includes an aperture having an elongate slot portion 249 with a semi-circular portion 250 at a centre thereof through which the air fans out, in use, towards both the first column of molding cavities 103 and the second column of molding cavities 105.

In yet another alternative non-limiting embodiment, as shown in FIG. 6, the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 may otherwise include a nozzle outlet 348 of at least one of the first column of air nozzles 152, the second column of air nozzles 154 and the third column of air nozzles 156 has a pair of openings that includes a first aperture 349 and a second aperture 350 through which air fans out, in use, towards the first column of molding cavities 103 and the second column of molding cavities 105, respectively.

In yet another alternative non-limiting embodiment, not shown, the nozzle outlets (not shown) may be provided as channels or slots that are inclined, and connected with, the pressure channel 144. Furthermore, the in-mold molded article conveyance device 150 may further include an air pressure valve (not shown) with which to adjust air pressure within the pressure channel 144, whereby air velocity at the nozzle outlet 148 may be tuned for ejection requirements.

Thus having described various non-limiting embodiments of the injection mold 100 including an in-mold molded article conveyance device 150, the description shall turn to their operation within the context of a non-limiting embodiment of a method of injection molding 400. The injection molding process 400 is illustrated with reference to the flow chart of FIG. 7.

The injection molding process 400 is for the most part quite typical and as such the following well known steps will not be described in any detail:

- closing 402 the injection mold 100 to define the molding cavity 101 between the first mold portion 102 and the second mold portion 104;
- molding 404 the molded article 2 within the molding cavity 101 with injection and solidification of molding material therein;
- opening 406 of the injection mold 100 a distance that is sufficient to permit the molded article 2 to move along an interface 99 between the first mold portion 102 and the second mold portion 104 once ejected from the molding cavity 101; and
- ejecting 408 the molded article 2 from the molding cavity 101.

Where the process 400 deviates from the known process is in a final step of directing 410 air through the first column of air nozzles 152 and the second column of air nozzles 154 of the in-mold molded article conveyance device 150 to entrain the molded article 2 in the air corridor 151 formed therebetween and the first confronting face 141 and the second confronting face 131 of the first mold portion 102 and the second mold portion 104. The technical effect of the foregoing may include accelerated conveyance towards a perimeter 143 of the injection mold 100 – such that the injection mold 100 may close more quickly for sake of improved molding efficiency. The steps of ejecting 408 and directing 410 may be performed sequentially or simultaneously.

It is noted that the foregoing has outlined some of the more pertinent non-limiting embodiments of the present invention. This invention may be used for many applications. Thus, although the description is made for particular arrangements and methods, the intent and concept of the invention is suitable and applicable to other arrangements and applications. It will be clear to those skilled in the art that modifications to the disclosed embodiments can be effected without departing from the spirit and scope of the invention. The described embodiments ought to be construed to be merely illustrative of some of the more prominent features and applications of the invention. Other beneficial results can be realized by applying the disclosed invention in a different manner or modifying the invention in ways known to those familiar with the art. This includes the mixing and matching of features, elements and/or functions between various embodiments 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.

WHAT IS CLAIMED IS:

1. A molding apparatus, comprising:
an in-mold molded article conveyance device (150) including a first column of air nozzles (152) and a second column of air nozzles (154) with which to bracket, in use, a molding cavity (101) along an interface (99) between a first mold portion (102) and a second mold portion (104) of an injection mold (100), and wherein the first column of air nozzles (152) and the second column of air nozzles (154) are oriented to generate, in use, an air corridor (151) therebetween within which a molded article (2) is entrainable, upon ejection from the molding cavity (101), for accelerated conveyance towards a perimeter (143) of the injection mold (100).
2. The molding apparatus according to claim 1, further comprising:
the injection mold (100) including the first mold portion (102) and the second mold portion (104) that are configured to define, in use, the molding cavity (101) therebetween within which the molded article (2) is moldable.
3. The molding apparatus according to claim 1, wherein:
the air corridor (151) is further defined between a first confronting face (141) and a second confronting face (131) of the first mold portion (102) and the second mold portion (104), respectively, when spaced apart.
4. The molding apparatus according to claim 1, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are substantially parallel.
5. The molding apparatus according to claim 1, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are arranged such that the air corridor (151) includes at least one of a straight portion and a curved portion.
6. The molding apparatus according to claim 1, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are arranged such that the air corridor (151) is substantially vertical.

7. The molding apparatus according to claim 1, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are arranged such that the air corridor (151) is substantially horizontal.
8. The molding apparatus according to claim 1, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are oriented to dispense air towards one another at an inclined angle to an axis of the air corridor (151), whereby a first component (F_C) of the air dispensed therefrom centers the molded article (2) in the air corridor (151), whereas a remaining component (F_O) of the air dispensed therefrom pushes the molded article (2) therethrough.
9. The molding apparatus according to claim 2, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are associated with the first mold portion (102).
10. The molding apparatus according to claim 9, wherein:
the in-mold molded article conveyance device (150) further includes a first column of complementary air nozzles and a second column of complementary air nozzles that are associated with the second mold portion (104) with which to cooperate with the first column of air nozzles (152) and the second column of air nozzles (154) to further define the air corridor (151).
11. The molding apparatus according to claim 9, wherein:
the first column of air nozzles (152) and the second column of air nozzles (154) are associated with a plate (142) of a first mold shoe (140) in the first mold portion (102), and wherein each of the first column of air nozzles (152) and the second column of air nozzles (154) includes a nozzle outlet (148, 248, 348) that is defined in a nozzle insert (146) that is configured to overly a pressure channel (144) that is defined in the plate (142).
12. The molding apparatus according to claim 11, wherein:
the in-mold molded article conveyance device (150) further includes an air pressure valve with which to adjust air pressure within the pressure channel (144), whereby air velocity at the nozzle outlet (148) may be tuned for ejection requirements.

13. The molding apparatus according to claim 2, wherein:
the first mold portion (102) and the second mold portion (104) cooperate, in use, to define a first column of molding cavities (103), included in which is the molding cavity (101), and wherein the first column of air nozzles (152) and the second column of air nozzles (154) bracket the first column of molding cavities (103) for entraining, in use, molded articles ejected therefrom.
14. The molding apparatus according to claim 13, wherein:
the first mold portion (102) and the second mold portion (104) cooperate, in use, to define a second column of molding cavities (105), and wherein the in-mold molded article conveyance device (150) is configured to define another air corridor (153) for entraining, in use, the molded articles ejected therefrom.
15. The molding apparatus according to claim 14, wherein:
the second column of air nozzles (154) are oriented to dispense air towards the first column of molding cavities (103) and the second column of molding cavities (105);
and
the in-mold molded article conveyance device (150) further includes a third column of air nozzles (156), wherein the second column of air nozzles (154) and the third column of air nozzles (156) bracket the second column of molding cavities (103) along the interface (99) between the first mold portion (102) and the second mold portion (104), and wherein the second column of air nozzles (154) and the third column of air nozzles (156) are oriented to generate, in use, the air corridor (153) therebetween.
16. The molding apparatus according to claim 15, wherein:
a nozzle outlet (148) of at least one of the first column of air nozzles (152), the second column of air nozzles (154) and the third column of air nozzles (156) has a semi-circular aperture that outlines a deflector (149) that is inclined towards an air pressure channel (144), whereby the air is deflected, in use, by the deflector (149) to fan out through the semi-circular aperture towards both the first column of molding cavities (103) and the second column of molding cavities (105).
17. The molding apparatus according to claim 15, wherein:

a nozzle outlet (248) of at least one of the first column of air nozzles (152), the second column of air nozzles (154) and the third column of air nozzles (156) has an aperture that includes an elongate slot portion (249) with a semi-circular portion (250) at a centre thereof through which the air fans out, in use, towards both the first column of molding cavities (103) and the second column of molding cavities (105).

18. The molding apparatus according to claim 15, wherein:

a nozzle outlet (348) of at least one of the first column of air nozzles (152), the second column of air nozzles (154) and the third column of air nozzles (156) has a pair of openings that includes a first aperture 349 and a second aperture 350 through which air fans out, in use, towards the first column of molding cavities (103) and the second column of molding cavities (105), respectively.

19. A process (400) for injection molding a molded article (2), comprising:

closing (402) an injection mold (100) to define a molding cavity (101) between a first mold portion (102) and a second mold portion (104);

molding (404) the molded article (2) within the molding cavity (101) with the injection and solidification of molding material therein;

opening (406) of the injection mold (100) a distance that is sufficient to permit the molded article (2) to move along an interface (99) between the first mold portion (102) and the second mold portion (104) once ejected from the molding cavity (101);

ejecting (408) the molded article (2) from the molding cavity (101); and

directing (410) air through a first column of air nozzles (152) and a second column of air nozzles (154) of an in-mold molded article conveyance device (150) that bracket the molding cavity (101) along the interface (99) to form an air corridor (151) within which the molded article (2) is entrainable for accelerated conveyance towards a perimeter (143) of the injection mold (100).

20. The process (400) according to claim 19, wherein:

ejecting (408) and directing (410) are performed sequentially or simultaneously.

1 / 2

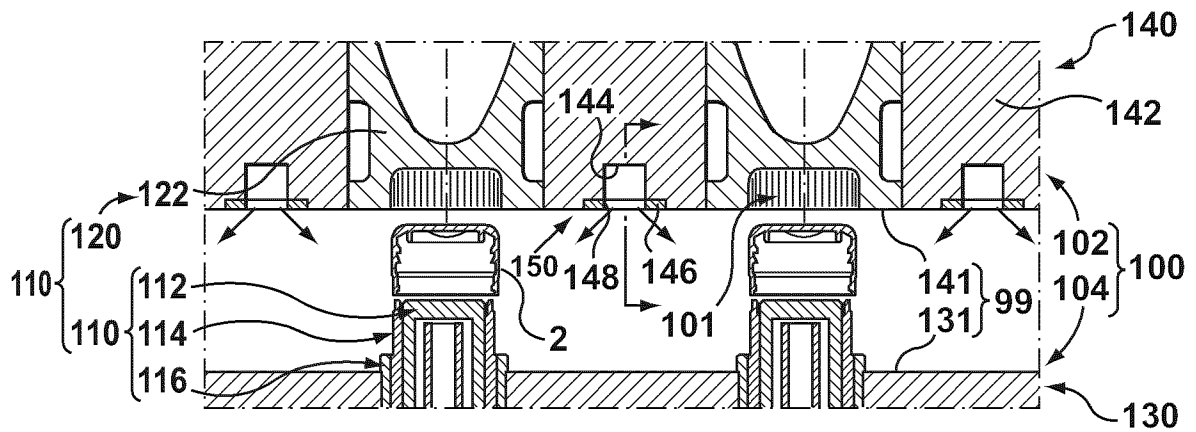


FIG. 1

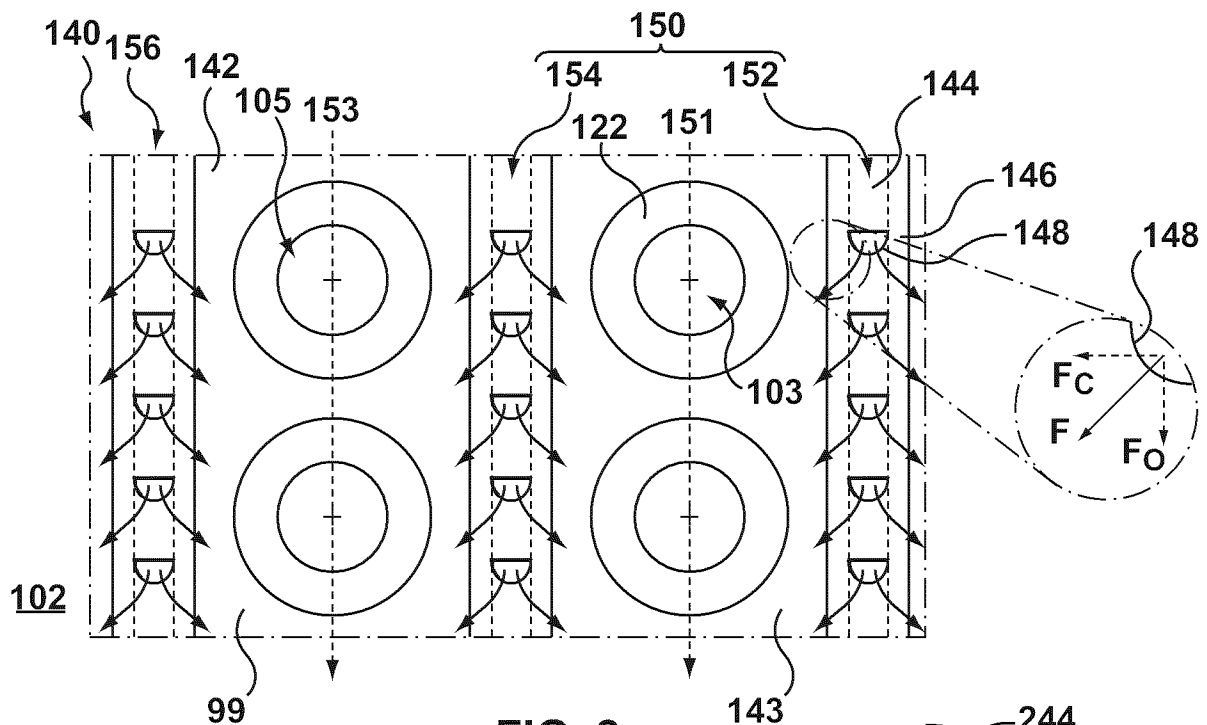


FIG. 2

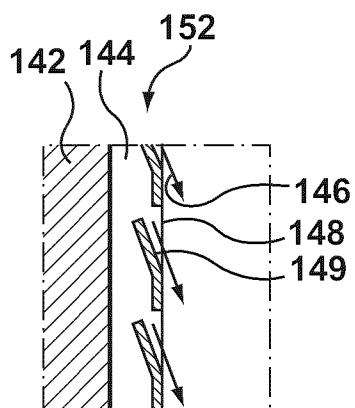


FIG. 3

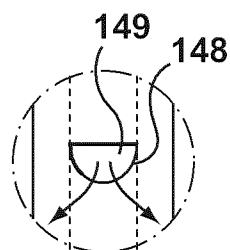


FIG. 4

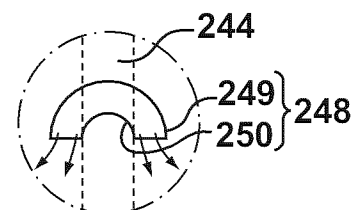


FIG. 5

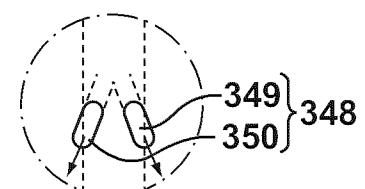
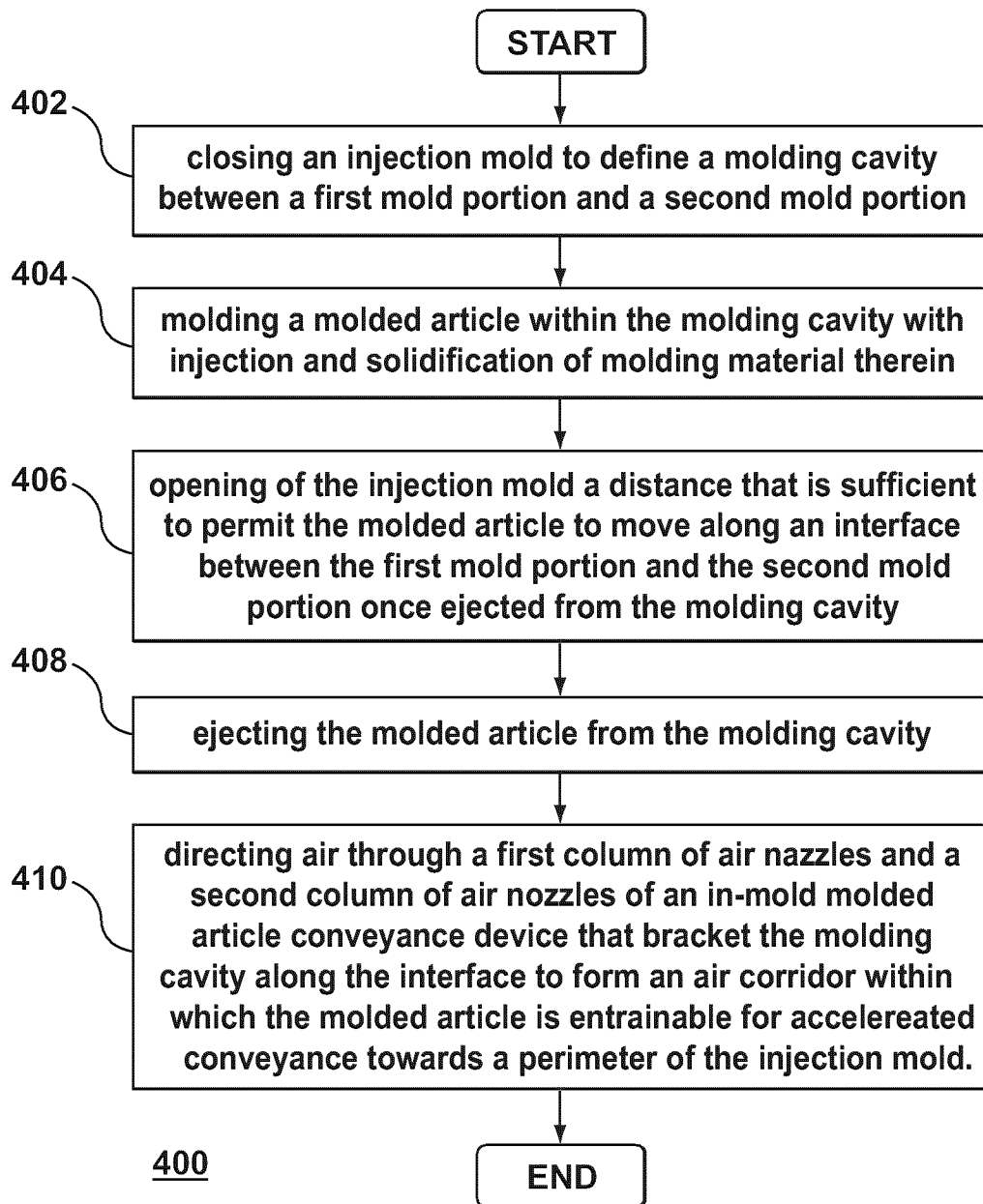


FIG. 6

2 / 2

**FIG. 7**

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2011/050555

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B29C 45/43** (2006.01) , **B29C 45/26** (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)

IPC: **B29C** (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)

EPOQUE (EPODOC and X-FULL), CPD with key words, such as: mould*, mold*, eject*, remov*, air transfer*/convey*/flow*/jet*/nozzle*/channel/corridor*, float* and entrain*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 10193409 A (NAKAJIMA, K) 28 July 1998 (28-07-1998) *whole document*	1-20
A	WO 03/045823 A1 (WEIDENMÜLLER, R.) 05 June 2003 (05-06-2003) *cited by applicant* *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

13 October 1998 (13-10-1998)

Date of mailing of the international search report

24 October 2011 (24-10-2011)

Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
Place du Portage I, C114 - 1st Floor, Box PCT
50 Victoria Street
Gatineau, Quebec K1A 0C9
Facsimile No.: 001-819-953-2476

Authorized officer

Pengfei Zhang (819) 953-0654

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2011/050555

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
JP 10193409 A	28 July 1998 (28-07-1998)	None	
WO 03/045823 A1	05 June 2003 (05-06-2003)	AT363448T AU2002365501A1 DE10157703A1 DE10157703B4 DE50210247D1 EP1448466A1 EP1448466B1 ES2287359T3 US2005069390A1 US7223060B2	15 June 2007 (15-06-2007) 10 June 2003 (10-06-2003) 12 June 2003 (12-06-2003) 06 May 2004 (06-05-2004) 12 July 2007 (12-07-2007) 25 August 2004 (25-08-2004) 30 May 2007 (30-05-2007) 16 December 2007 (16-12-2007) 31 March 2005 (31-03-2005) 29 May 2007 (29-05-2007)