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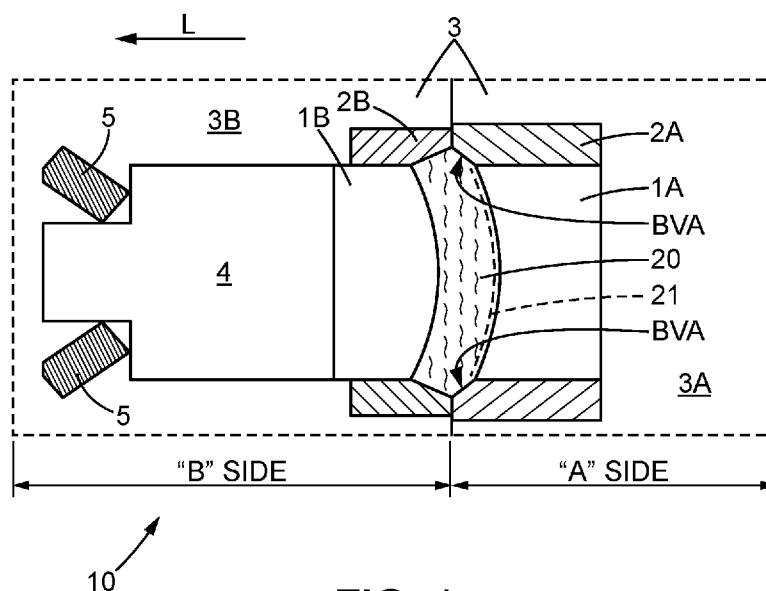


FIG. 1

(57) Abstract: A process for manufacturing an ophthalmic or semi-finished lens (20) using injection-molding comprises implementing a receiver (2A) that is provided with a bevel sized for avoiding that the lens sticks to said receiver when removing said lens from a cavity assembly (10). An invention improvement further proposes modifying a location in the cavity assembly of a temperature sensor which is used for controlling a temperature time-profile implemented in the injection-molding process. The invention process provides increased production yield, including for lenses which integrate functionalizing wafers or lids (21), such as polarizing lenses or spectrally filtering lenses.



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**MANUFACTURING OF AN OPHTHALMIC OR SEMI-FINISHED LENS USING
INJECTION-MOLDING WITH IN-MOLD COINING**

The invention relates to a process for manufacturing an ophthalmic or semi-finished lens using injection-molding.

-- BACKGROUND OF THE INVENTION --

Injection-molding of a thermoplastic material is commonly used for manufacturing an ophthalmic or semi-finished lens. An improvement of such process which is further known consists in additionally implementing In-Mold Coining (IMC). Such improvement allows better control of the optical surfaces of the ophthalmic lens or optical surface of the semi-finished lens thanks to maintaining pressure on the optical surface(s) of the lens being molded during the cooling process. Optical surfaces that are more difficult to achieve such as progressive addition surfaces or surfaces with high base values can be thus produced with increased production yield.

Injection-molding with In-Mold Coining (IMC) is described in particular in document US 2006/0267226 A1.

However, a first issue is that the lens remains sometimes attached to the mold when opening this latter after cooling-down. Due to such attachment, removal of the lens from the mold can no longer be carried out by a dedicated machine, but it requires being performed manually by an operator. This needs stopping the automatic operation of the injection equipment and causes waste of time in the production schedule. The attachment occurs on the A-side of the mold, i.e. on the mold side that corresponds to the convex optical surface of the lens.

Another issue relates to special lenses such as polarizing lenses or filtering lenses. Such functionalized lenses are manufactured by injection-molding in combination with arranging a polarizing wafer or a filtering lid in the

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mold cavity before injecting the thermoplastic material therein. The wafer or lid is applied against the internal surface of the mold that defines the convex optical surface of the lens. In this way, the wafer or lid confers additional functions to the lens, such as light polarization or filtering. But implementing the
5 wafer or lid without the use of In-Mold Coining (IMC) reduces the accuracy of the process control, so the optical surfaces of the manufactured lenses happen to be out of specifications, leading again to reduction in the production yield.

Starting from this situation, a first object of the present invention consists in suppressing the need for an operator to manually remove some of
10 the lenses from the mold.

Another object of the invention consists in improving control of the injection-molding process when implementing In-Mold Coining.

Still another object of the invention consists in improving production yield for lenses that incorporate wafers or lids which are arranged in the mold
15 before injection.

-- SUMMARY OF THE INVENTION --

For meeting at least one of these objects or others, a first aspect of the present invention proposes a process for manufacturing an ophthalmic or semi-finished lens using injection-molding of a thermoplastic material, which process
20 comprises the following steps:

/1/ providing a cavity assembly for performing the injection-molding, in which a convex surface and a concave surface of the lens to be molded, which are opposite each other and connected by a peripheral edge surface of the lens, are defined by an A-side insert and a B-side
25 insert respectively, the A-side insert and B-side insert being accommodated in an A-side receiver and a B-side receiver respectively, the A-side receiver and B-side receiver being in mutual abutting contact during the injection-molding along the peripheral edge surface of the lens, so that the A-side insert, A-side receiver, B-side
30 receiver and B-side insert together define a mold cavity;

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/2/ injecting the thermoplastic material into the mold cavity, between the A-side insert and the B-side insert;

/3/ cooling the cavity assembly containing the thermoplastic material; then

5 /4/ moving the A-side receiver and the B-side receiver apart from each other, and removing the lens comprising the injected thermoplastic material from the cavity assembly.

In the invention process, the cavity assembly is adapted so that at least one of the A-side insert and B-side insert is slidable within the A-side receiver or B-side receiver, respectively, parallel to a longitudinal axis of the A-side insert. The cavity assembly is furthermore adapted for pressing the A-side
10 insert and the B-side insert towards each other at least during step /3/. Thus, the cavity assembly that is used implements In-Mold Coining.

According to the invention, the A-side receiver is provided internally with a bevel along an end edge thereof that abuts the B-side receiver in the
15 cavity assembly during steps /2/ and /3/, this bevel having a depth which is comprised between 0.768 mm (0.03 inch) and 12.8 mm (0.50 inch) when measured parallel to the longitudinal axis. Thanks to such bevel, the occurrence of lens attachment to the A-side receiver in step /4/ is reduced or suppressed, thereby allowing an increase in the process capability of the
20 injection-molding process using In-Mold Coining. In particular, manual removal of the injected lens from the cavity assembly by an operator is required less often or no longer necessary.

Preferably, the bevel may extend along an entire circumference of the end edge of the A-side receiver, about a central axis of this A-side receiver.
25 Removal of the injected lens from the cavity assembly can be performed even more easily without intervention of the operator. Advantageously, the bevel may extend continuously along the circumference of the end edge of the A-side receiver, possibly in combination with a gate provided for injection of the thermoplastic material.

30 Also preferably, the depth of the bevel may be comprised between 2.048 mm (0.08 inch) and 12.8 mm (0.50 inch) when measured parallel to the

longitudinal axis.

Also preferably, a surface of the bevel may form an angle that is comprised between 4° (degree) and 30°, or better between 4° and 15°, with the longitudinal axis.

5 According to an improvement of the invention process, the cavity assembly may be thermally connected to a loop-shaped cooling circuit which is designed so that a projection of the cooling circuit onto a reference plane that is perpendicular to the longitudinal axis surrounds a projection of the mold cavity onto this reference plane. Then, the process may comprise arranging a center
10 temperature sensor that has a first projection in the reference plane located within a loop of the projected cooling circuit (for example as shown non-limitedly in Figure 3 with reference number 13), and also arranging an outer temperature sensor that has a second projection in the reference plane located
15 outside of the loop of the projected cooling circuit (for example as shown non-limitedly in Figure 3 with reference number 14). With such arrangement, the process may further comprise:

- determining a target temperature time-profile for the thermoplastic material to be achieved during steps /2/ and /3/;
- determining a control temperature time-profile to be achieved at the
20 outer temperature sensor, so that achieving this control temperature time-profile at the outer temperature sensor during steps /2/ and /3/ makes the target temperature time-profile be achieved at the center temperature sensor; and
- controlling coolant-pumping means (for example as shown non-limitedly
25 in Figure 3 with reference number 18) that are arranged for injecting a coolant into the cooling circuit (for example as shown non-limitedly in Figure 3 with reference number 17), using measured temperature values which are delivered by the outer temperature sensor as a feedback signal, so that the control temperature time-profile is achieved
30 at the outer temperature sensor during steps /2/ and /3/.

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Thanks to implementing in this way the center temperature sensor and the outer temperature sensor, the actual temperature of the thermoplastic material being molded can be controlled with improved accuracy. Indeed, the temperature measurement signal that is outputted by the outer temperature
5 sensor has less noise than that outputted by the center temperature sensor. Feedback-control during steps /2/ and /3/ can thus be achieved more finely by using the outer temperature sensor for providing the feedback signal.

For manufacturing functionalized lenses, the invention process may further comprise the following additional step between steps /1/ and /2/:

10 - arranging a wafer or lid in the mold cavity against the A-side insert.

Such wafer or lid provides functionalization of the manufactured lens. For example, using a polarizing wafer provides light-polarization capability to the lens for light that passes through the lens, and using a filtering lid provides spectral light-filtering capability to the lens for the light that passes
15 therethrough. Then, the thermoplastic material is injected in step /2/ between the wafer or lid and the B-side insert. In particular, such implementation of the invention process makes it possible to manufacture functionalized lenses that include each a wafer or lid, with these lenses having convex optical surfaces that have high base values or progressive designs.

20 Possibly, at least part of the wafer or lid may be based on polycarbonate. But other materials are also possible for forming part of the wafer or lid.

Generally for the invention, the thermoplastic material which is injected into the mold cavity in step /2/ may be based on polycarbonate. But other
25 thermoplastic materials may be used alternatively.

Again generally for the invention, the A-side receiver may have a cylindrical internal surface with diameter of this cylindrical internal surface which is comprised between 50 mm (1.953 inches) and 90 mm (3.516 inches). This cylindrical internal surface of the A-side receiver surface contacts a
30 peripheral surface of the A-side insert at least during steps /2/ and /3/.

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A second aspect of the invention proposes a receiver that is suitable for being part of a cavity assembly adapted for injection-molding of an ophthalmic or semi-finished lens with implementing In-Mold Coining. This receiver is designed for accommodating an insert that is intended to define a convex surface of the lens, and for abutting another receiver along an end edge of the invention receiver. Then, this end edge of the invention receiver is provided internally with a bevel which has a depth comprised between 0.768 mm (0.03 inch) and 12.8 mm (0.50 inch) when measured parallel to a longitudinal axis of this invention receiver. Preferably, this bevel depth may extend along the entire circumference of the end edge of the A-side receiver, about a central axis of this A-side receiver, and/or be comprised between 2.048 mm (0.08 inch) and 12.8 mm (0.50 inch). Also preferably, a surface of the bevel may form an angle that is comprised between 4° and 30°, preferably comprised between 4° and 15°, with the longitudinal axis. Possibly, the invention receiver may have a cylindrical internal surface with diameter comprised between 50 mm (1.953 inches) and 90 mm (3.516 inches).

A third aspect of the invention proposes a cavity assembly which is adapted for injection-molding of a thermoplastic material in order to manufacture an ophthalmic or semi-finished lens, this cavity assembly comprising:

- an A-side insert and a B-side insert suitable for defining a convex surface and a concave surface, respectively, of the lens;
- an A-side receiver and a B-side receiver designed for accommodating the A-side insert and B-side insert, respectively; and
- an injection module portion, adapted for maintaining the A-side receiver and B-side receiver in mutual abutting contact during the injection-molding along respective end edges of said A-side receiver and B-side receiver, so that the A-side insert, A-side receiver, B-side receiver and B-side insert together define a mold cavity that corresponds to the lens.

The cavity assembly is adapted for implementing In-Mold Coining. To this end, at least one of the A-side insert and B-side insert is slidable within the

A-side receiver or B-side receiver, respectively, parallel to a longitudinal axis of the A-side insert, and the injection module portion is furthermore adapted for pressing the A-side insert and the B-side insert towards each other at least during a cooling step applied to the cavity assembly.

5 According to the invention, the A-side receiver in the invention cavity assembly is provided internally with a bevel along its end edge, this bevel having a depth comprised between 0.768 mm (0.03 inch) and 12.8 mm (0.50 inch) when measured parallel to the longitudinal axis. Hence, the A-side receiver in the invention cavity assembly meets the second invention aspect.

10 The invention cavity assembly may optionally further have the preferred features that relate to this assembly and have been recited above in connection with the first invention aspect.

In particular, the bevel may extend along the entire circumference of the end edge of the A-side receiver, about a central axis of this latter.

15 A fourth aspect of the invention proposes an injection mold which comprises:

- at least one cavity assembly according to the third invention aspect;
- a loop-shaped cooling circuit which is designed so that a projection thereof onto a reference plane that is perpendicular to the longitudinal axis surrounds a projection of each mold cavity onto this reference plane;
- 20 - a center temperature sensor that has a first projection in the reference plane located within a loop of the projected cooling circuit;
- 25 - an outer temperature sensor that has a second projection in the reference plane located outside of the loop of the projected cooling circuit;
- 30 - coolant-pumping means arranged for injecting a coolant into the cooling circuit; and
- a control unit that is connected to the outer temperature sensor for receiving measured temperature values which are delivered by this

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outer temperature sensor as a feedback signal, and configured for controlling the coolant-pumping means based on the measured temperature values delivered by the outer temperature sensor, so that temperature existing at the outer temperature sensor achieves a control temperature time-profile that makes another temperature existing at the center temperature sensor achieve a target temperature time-profile.

-- BRIEF DESCRIPTION OF THE DRAWINGS --

Figure 1 is a cross-sectional view of a cavity assembly according to the invention;

Figure 2 is a cross-sectional view of an A-side receiver as comprised in the cavity assembly of Figure 1; and

Figure 3 is an in-plane view of an injection mold according to an improvement of the invention.

For clarity sake, element sizes which appear in these figures do not correspond to actual dimensions or dimension ratios. Also, same reference numbers which are indicated in different ones of these figures denote identical elements of elements with identical function.

-- DETAILED DESCRIPTION OF THE INVENTION --

Figure 1 shows a cavity assembly 10 which is suitable for injection-molding a lens 20 by implementing In-Mold Coining. The cavity assembly 10 comprises two inserts for defining two opposite surfaces of the lens 20: a so-called A-side insert 1A for defining a convex surface of the lens 20, and a so-called B-side insert 1B for defining a concave surface of the lens 20. The insert 1A is accommodated within a first receiver 2A, called A-side receiver, and the insert 1B is accommodated within a second receiver 2B, called B-side receiver. Both receivers 2A and 2B abut each other along respective end edges thereof, whereas both inserts 1A and 1B are apart from each other, so as to define a mold cavity that corresponds to the lens 20 to be manufactured. The receivers

2A and 2B are maintained in abutting configuration during injection-molding by a peripheral injection module portion 3. The insert 1A, respectively 1B, can slide within the receiver 2A, resp. 2B, along a common longitudinal axis L. The injection module portion 3 sets a position of the insert 1A along the longitudinal axis L, by providing backstop to this insert 1A. Simultaneously, an intermediate portion 4 transmits a counterforce to the insert 1B. To this purpose, two springs 5 are arranged in the injection module portion 3 so as to push the intermediate portion 4 and also the insert 1B towards the insert 1A, parallel to the longitudinal axis L. Such cavity assembly 10 suits for implementing In-Mold Coining in a manner well-known by people experienced in injection-molding. In particular, In-Mold Coining allows better accuracy in the shape of the convex and concave surfaces of the molded lens.

Manufacturing of the lens 20 is achieved by the following molding process sequence: heating the cavity assembly 10, then injecting a thermoplastic material into the mold cavity, then cooling down the cavity assembly 10 and opening it for removing the lens 20. Opening of the cavity assembly 10 is obtained by separating two parts of the injection module portion 3 which are denoted 3A and 3B in Figure 1. The parts 3A and 3B are designed so that separation leads to the insert 1A and the receiver 2A remain within part 3A on the one hand, and the insert 1B and the receiver 2B remain within part 3B on the other hand. Such mold opening allows removal of the lens 20, but it may happen that this lens 20 sticks to the receiver 2A, causing disturbance in automatic successive executions of the molding process sequence. The invention now described avoids this sticking issue for the lens 20 in the receiver 2A. It consists in modifying this receiver 2A as shown in Figure 2.

Figure 2 shows the A-side receiver 2A, with the longitudinal axis L oriented consistently with Figure 1. The receiver 2A has a general shape of a hollow cylinder with circular internal section. The internal surface of the receiver 2A is denoted SA, and the diameter D of this internal surface may be 80 mm (millimeter). The end edge of the receiver 2A, which is intended to abut the receiver 2B during injection-molding is denoted EEA. According to the invention, the internal surface SA is provided with a bevel BVA at the end edge

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EEA. Preferably, the bevel BVA extends along the entire inner circumference of the end edge EEA of the receiver 2A, and thus connects this end edge EEA to the internal surface SA, continuously about a central axis of the receiver 2A that is parallel to the longitudinal axis L. Possible values for the bevel BVA that suppress lens attachment to the receiver when removing the lens 20 after injection and cooling down, are the following ones:

depth h of the bevel BVA: 2.816 mm (0.110 inch) when measured parallel to the longitudinal axis L; and

angle α of the bevel BVA relative to the longitudinal axis L: 10° .

10 Actually, for increasing a lens number that can be produced by one injection-molding equipment, an injection mold 100 to be fed with thermoplastic material from one injection nozzle (not shown) comprises several cavity assemblies 10, for example eight cavity assemblies combined as represented in Figure 3. Each cavity assembly is individually as shown in Figure 1.
15 Reference number 3 now denotes an injection module which is common to all cavity assemblies 10. In such injection molds provided with multiple cavities, the parts 3A and 3B of the injection module 3 correspond respectively to the movable platform and the fixed platform of the injection mold 100. Injection channels 11 connect the respective mold cavities of all the cavity assemblies
20 10 to the injection nozzle.

 The injection mold 100 further comprises a loop-shaped cooling circuit 17. This cooling circuit 17 surrounds all the cavity assemblies 10 within the injection module 3 as shown in Figure 3. The plane of this figure corresponds to the reference plane mentioned in the general part of the present description. A
25 coolant C is injected in the circuit 17 by suitable coolant-pumping means 18, at a flowrate which is controlled for producing desired cooling power.

 The injection mold 100 further comprises a first temperature sensor 13 which is dedicated to sensing temperature as existing at the cavity assemblies 10. To this end, the temperature sensor 13 is located within the loop of the
30 cooling circuit 17, in projection into the reference plane. This temperature sensor 13 is usually of the resistance thermal detector type, known as RTD-

type.

Finally, a control unit 19 is connected for receiving a current measured temperature value from the temperature sensor 13, and connected for controlling the coolant-pumping means 18. This control unit 19 may be of a commercially available type and is noted CTRL in Figure 3. It is configured for activating the coolant-pumping means 18 so that successive temperature values measured by the temperature sensor 13 achieve a prescribed target temperature time-profile. For such operation, the successive temperature values which are provided by the temperature sensor 13 are used as feedback values. The control unit 19 orders instant power values to the coolant-pumping means 18 so that the temperature values as measured by the temperature sensor 13 match the target temperature time-profile during each execution of the molding process sequence. This target temperature time-profile has been selected previously for allowing execution of injection-molding together with providing manufactured lenses which meet product and quality specifications, and also allowing reduced cycle duration.

However, the inventors have observed that the measured temperature values provided by the temperature sensor 13 contain an important noise contribution, in particular due to a glass transition undergone by the thermoplastic material when cooled down. As a consequence, the actual temperature of the lens 20 being molded may not sufficiently match the target temperature time-profile. This discrepancy is more important for lenses which are obtained each by placing a functionalizing wafer or lid 21 in each mold cavity before injection of the thermoplastic material. In general, such wafer or lid 21 is placed in each mold cavity close to the insert 1A as shown by an interrupted line in Figure 1. The thermoplastic material is then injected between the insert 1B and the wafer or lid 21, so that this latter forms the convex surface of the manufactured lens 20. Insufficient temperature control due to noise results in the lens surface formed by the wafer or lid 21 not meeting the product and quality requirements for a number of the manufactured lenses.

For alleviating this issue, an improvement of the invention proposes replacing the temperature sensor 13 by another one denoted with reference

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number 14 in Figure 3. The temperature sensor 14 is located outside the loop of the cooling circuit 17, in projection into the reference plane. The temperature sensor 14 may be of RTD-type too. The temperature sensors 13 and 14 have been called center temperature sensor and outer temperature sensor, respectively, referring to their locations with respect to the cooling circuit 17. Thanks to the location of the temperature sensor 14 further from the mold cavities 10, it provides measured temperature values which have less noise contribution compared to the measured temperature values provided by the temperature sensor 13. Then, the control unit 19 uses measured temperature values received from the temperature sensor 14, for controlling the coolant-pumping means 18. The temperature time-profile that is used by the control unit 19 needs then to be adapted, in order to compensate for the replacement of the temperature sensor 13 with the temperature sensor 14. The new temperature time-profile to be used can be determined experimentally and is called control temperature time-profile. It is determined so that achieving the control temperature time-profile at the location of the temperature sensor 14 causes the temperature at the location of the temperature sensor 13 to follow the target temperature time-profile.

In particular, the invention may be applied with the following constitution of the lens 20:

- the thermoplastic material which is injected in each mold cavity may be based on polycarbonate;
- part of the insert or lid 21 may also be based on polycarbonate;
- the functionalizing wafer may include a polarizing film, or the functionalizing lid may include a spectral filter. In each case, the wafer or lid 21 may also include appropriate protecting films and bonding layers in addition to the polarizing film or spectral filter; and
- the lens 20 may be an ophthalmic lens or a semi-finished lens, depending on whether its concave surface as defined by the B-side insert 1B is intended to be machined later in accordance with a prescription of a wearer of the lens.

CLAIMS

1. A process for manufacturing an ophthalmic or semi-finished lens (20) using injection-molding of a thermoplastic material, comprising the following steps:

- 5 /1/ providing a cavity assembly (10) for performing the injection-molding, in which a convex surface and a concave surface of the lens (20) to be molded, which are opposite each other and connected by a peripheral edge surface of the lens, are defined by an A-side insert (1A) and a B-side insert (1B) respectively, said A-side insert and B-side insert being
10 accommodated in an A-side receiver (2A) and a B-side receiver (2B) respectively, the A-side receiver and B-side receiver being in mutual abutting contact during the injection-molding along the peripheral edge surface of the lens, so that the A-side insert, A-side receiver, B-side receiver and B-side insert together define a mold cavity;
- 15 /2/ injecting the thermoplastic material into the mold cavity, between the A-side insert (1A) and the B-side insert (1B);
- /3/ cooling the cavity assembly (10) containing the thermoplastic material; then
- /4/ moving the A-side receiver (2A) and the B-side receiver (2B) apart
20 from each other, and removing the lens (20) comprising the injected thermoplastic material from the cavity assembly (10),

wherein the cavity assembly (10) is adapted so that at least one of the A-side insert (1A) and B-side insert (1B) is slidable within the A-side receiver (2A) or B-side receiver (2B), respectively, parallel to a longitudinal axis (L) of said A-side insert, and the cavity assembly is furthermore adapted for pressing the A-side insert and the B-side insert towards each other at least during step /3/,

25

and wherein the A-side receiver (2A) is provided internally with a bevel (BVA) along an end edge (EEA) of said A-side receiver that abuts the B-side receiver (2B) in the cavity assembly (10) during steps /2/ and /3/, said bevel having a

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depth (h) comprised between 0.768 mm and 12.8 mm when measured parallel to the longitudinal axis (L).

2. The process of claim 1, wherein the bevel (BVA) extends along an entire circumference of the end edge (EEA) of the A-side receiver (2A), about a
5 central axis of said A-side receiver.

3. The process of claim 1 or 2, wherein the depth (h) of the bevel (BVA) is comprised between 2.048 mm and 12.8 mm when measured parallel to the longitudinal axis (L).

4. The process of one of the preceding claims, wherein a surface of the
10 bevel (BVA) forms an angle (α) that is comprised between 4° and 30° , preferably comprised between 4° and 15° , with the longitudinal axis (L).

5. The process of one of the preceding claims, wherein the cavity assembly (10) is thermally connected to a loop-shaped cooling circuit (17) which is designed so that a projection of the cooling circuit onto a reference
15 plane that is perpendicular to the longitudinal axis (L) surrounds a projection of the mold cavity onto said reference plane,

and the process comprises arranging a center temperature sensor (13) that has a first projection in the reference plane located within a loop of the projected cooling circuit, and also arranging an outer temperature sensor (14) that has a
20 second projection in said reference plane located outside of the loop of the projected cooling circuit,

and wherein the process further comprises:

- determining a target temperature time-profile for the thermoplastic material to be achieved during steps /2/ and /3/;
- 25 - determining a control temperature time-profile to be achieved at the outer temperature sensor (14), so that achieving said control temperature time-profile at said outer temperature sensor during steps /2/ and /3/ makes the target temperature time-profile be achieved at the center temperature sensor (13); and

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- controlling coolant-pumping means (18) that are arranged for injecting a coolant into the cooling circuit (17), using measured temperature values which are delivered by the outer temperature sensor (14) as a feedback signal, so that the control temperature time-profile is achieved
5 at the outer temperature sensor during steps /2/ and /3/.

6. The process of one of the preceding claims, further comprising the following additional step between steps /1/ and /2/:

- arranging a wafer or lid (21) in the mold cavity against the A-side insert (1A),

10 and wherein the thermoplastic material is injected in step /2/ between the wafer or lid (21) and the B-side insert (1B).

7. The process of claim 6, wherein at least part of the wafer or lid (21) is based on polycarbonate.

8. The process of claim 6 or 7, wherein the wafer or lid (21) is a polarizing
15 wafer suitable for polarizing light that passes through the manufactured lens (20), or a filtering lid suitable for spectrally filtering light that passes through the manufactured lens.

9. The process of one of the preceding claims, wherein the thermoplastic material which is injected into the mold cavity in step /2/ is based on
20 polycarbonate.

10. The process of one of the preceding claims, wherein the A-side receiver (2A) has a cylindrical internal surface (SA) with diameter (D) comprised between 50 mm and 90 mm, said cylindrical internal surface contacting a peripheral surface of the A-side insert (1A) at least during steps /2/
25 and /3/.

11. A receiver (2A) suitable for being part of a cavity assembly (10) adapted for injection-molding of an ophthalmic or semi-finished lens (20) with implementing In-Mold Coining, wherein the receiver is designed for

accommodating an insert (1A) that is intended to define a convex surface of the lens, and for abutting another receiver (2B) along an end edge (EEA) of said receiver, said end edge of the receiver being provided internally with a bevel (BVA) which has a depth (h) comprised between 0.768 mm and 12.8 mm when
5 measured parallel to a longitudinal axis (L) of the receiver.

12. The receiver (2A) of claim 11, wherein the bevel (BVA) extends along an entire circumference of the end edge (EEA) of the A-side receiver (2A), about a central axis of said A-side receiver.

13. The receiver (2A) of claim 11 or 12, wherein the depth (h) of the bevel
10 (BVA) is comprised between 2.048 mm and 12.8 mm when measured parallel to the longitudinal axis (L).

14. The receiver (2A) of one of claims 11 to 13, wherein a surface of the bevel forms an angle (α) that is comprised between 4° and 30°, preferably comprised between 4° and 15°, with the longitudinal axis (L).

15. The receiver (2A) of one of claims 11 to 14, having a cylindrical internal surface (SA) with diameter (D) of said cylindrical internal surface comprised between 50 mm and 90 mm.

16. A cavity assembly (10) adapted for injection-molding of a thermoplastic material in order to manufacture an ophthalmic or semi-finished lens (20),
20 which comprises:

- an A-side insert (1A) and a B-side insert (1B) suitable for defining a convex surface and a concave surface, respectively, of the lens (20);
- an A-side receiver (2A) and a B-side receiver (2B) designed for accommodating the A-side insert (1A) and B-side insert (1B),
25 respectively; and
- an injection module portion (3), adapted for maintaining the A-side receiver (2A) and B-side receiver (2B) in mutual abutting contact during the injection-molding along respective end edges of said A-side receiver and B-side receiver, so that the A-side insert (1A), A-side

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receiver, B-side receiver and B-side insert (1B) together define a mold cavity that corresponds to the lens (20),

wherein at least one of the A-side insert (1A) and B-side insert (1B) is slidable within the A-side receiver (2A) or B-side receiver (2B), respectively, parallel to a longitudinal axis (L) of said A-side insert, and the injection module portion (3) is furthermore adapted for pressing the A-side insert and the B-side insert towards each other at least during a cooling step applied to the cavity assembly (10),

and wherein the A-side receiver (2A) is provided internally with a bevel (BVA) along the end edge (EEA) of said A-side receiver, said bevel having a depth (h) comprised between 0.768 mm and 12.8 mm when measured parallel to the longitudinal axis (L).

17. The cavity assembly (10) of claim 16, wherein the bevel (BVA) extends along an entire circumference of the end edge (EEA) of the A-side receiver (2A), about a central axis of said A-side receiver.

18. An injection mold (100) which comprises:

- at least one cavity assembly (10) according to claim 16 or 17;
- a loop-shaped cooling circuit (17) which is designed so that a projection of the cooling circuit onto a reference plane that is perpendicular to the longitudinal axis (L) surrounds a projection of each mold cavity onto said reference plane;
- a center temperature sensor (13) that has a first projection in the reference plane located within a loop of the projected cooling circuit;
- an outer temperature sensor (14) that has a second projection in the reference plane located outside of the loop of the projected cooling circuit;
- coolant-pumping means (18) arranged for injecting a coolant into the cooling circuit (17); and

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- 5 - a control unit (19) that is connected to the outer temperature sensor (14) for receiving measured temperature values which are delivered by said outer temperature sensor as a feedback signal, and configured for controlling the coolant-pumping means (18) based on the measured temperature values delivered by the outer temperature sensor, so that temperature existing at said outer temperature sensor achieves a control temperature time-profile that makes another temperature existing at the center temperature sensor (13) achieve a target temperature time-profile.

1/2

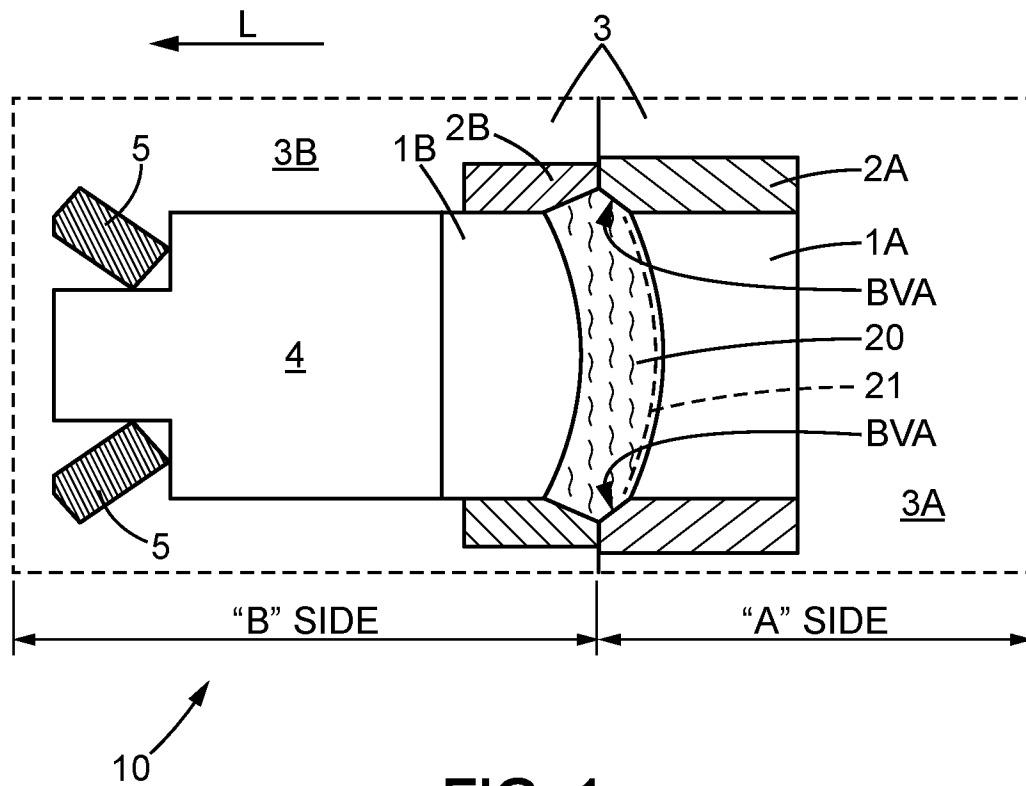


FIG. 1

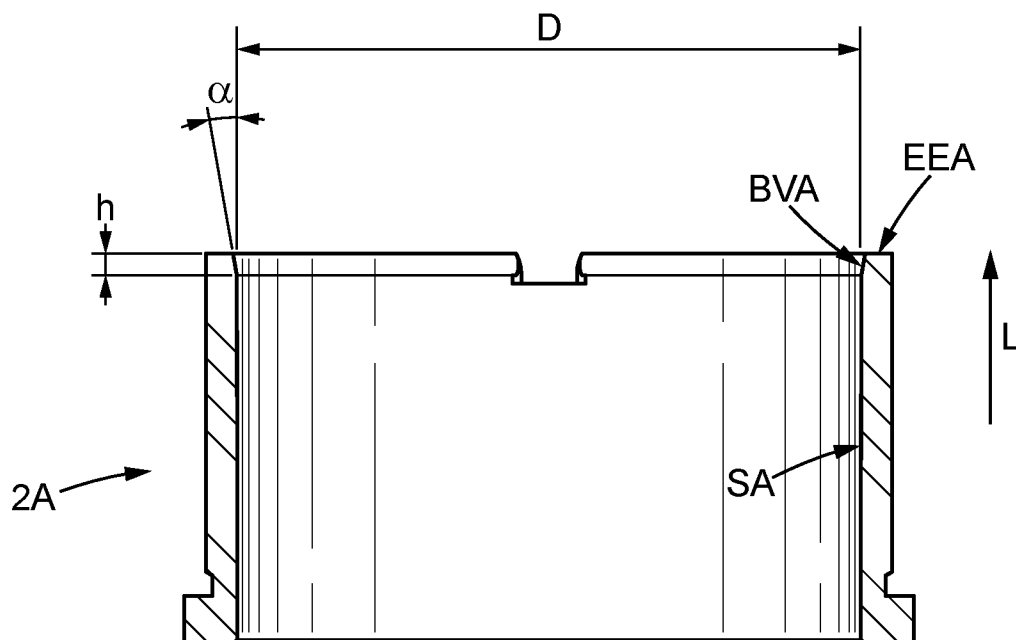


FIG. 2

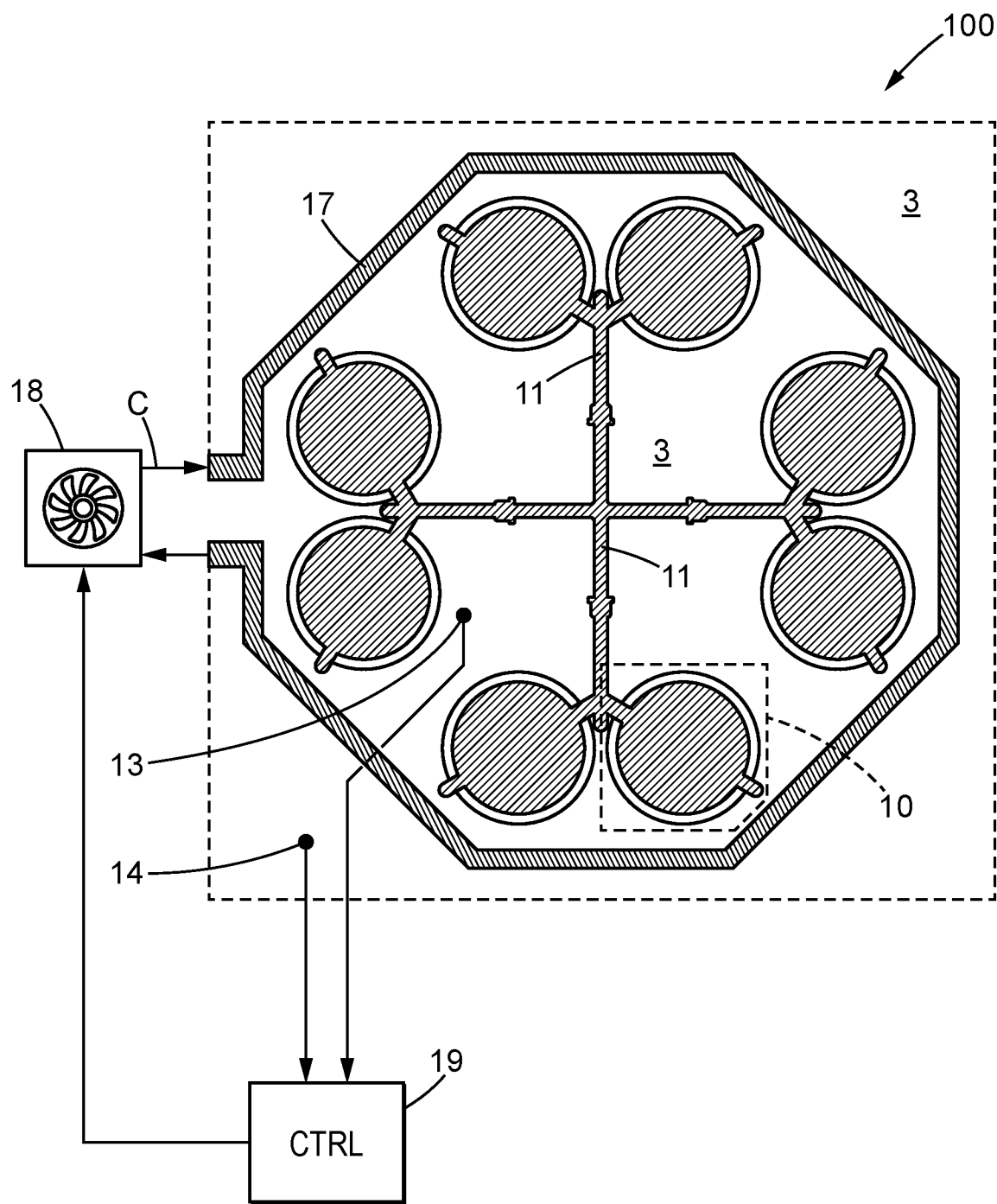


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/081755

A. CLASSIFICATION OF SUBJECT MATTER					
INV.	B29D11/00	B29C33/04	B29C35/16	B29C45/73	B29C45/78
	B29C45/56	B29C43/36	B29C43/50	B29C35/00	B29C35/02
ADD.	B29L11/00				
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) B29D B29C					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal					
C. DOCUMENTS CONSIDERED TO BE RELEVANT					
Category*	Citation of document, with indication, where appropriate, of the relevant passages				Relevant to claim No.
X	US 6 638 450 B2 (VTEC TECHNOLOGIES INC [US]) 28 October 2003 (2003-10-28)				1,3,4, 6-11, 13-16
A	abstract figures 1-5 column 5, lines 4-28 column 6, lines 17-31 column 6, lines 31-41 column 6, line 64 - column 7, line 10 column 7, lines 11-65 columns 5-7 ----- - / - -				2,5,12, 17,18
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.					
* Special categories of cited documents :					
"A" document defining the general state of the art which is not considered to be of particular relevance			"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		
"E" earlier application or patent but published on or after the international filing date			"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		
"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)			"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		
"O" document referring to an oral disclosure, use, exhibition or other means			"&" document member of the same patent family		
"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 28 April 2025			Date of mailing of the international search report 15/05/2025		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016			Authorized officer Heckmann, Paul		

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2024/081755

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/118594 A1 (NISHIMOTO TATSUO [JP] ET AL) 22 May 2008 (2008-05-22)	1, 3, 4, 9-11, 13-16
A	abstract figures 1-17 paragraphs [0074] - [0075], [0115] - [0134] -----	5-8, 12, 17, 18
X	US 2010/140819 A1 (CHIU HAO-WEN [US] ET AL) 10 June 2010 (2010-06-10)	11, 13-15
A	abstract figures 1-6C paragraphs [0032] - [0042] -----	1-10, 12, 16-18
A	US 2020/406518 A1 (HAQUE TAREQ [US] ET AL) 31 December 2020 (2020-12-31) abstract figures 1A-4B -----	1-18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2024/081755

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 6-17

A process for manufacturing an ophthalmic or semi-finished lens using injection-molding of a thermoplastic material, wherein the bevel extends along an entire circumference of the end edge of the A-side receiver, about a central axis of said A-side receiver.

2. claims: 5, 18

A process for manufacturing an ophthalmic or semi-finished lens using injection-molding of a thermoplastic material, wherein the process further comprises:

- determining a target temperature time-profile for the thermoplastic material to be achieved during steps /2/ and /3/;
- determining a control temperature time-profile to be achieved at the outer temperature sensor, so that achieving said control temperature time-profile at said outer temperature sensor during steps /2/ and /3/ makes the target temperature time-profile be achieved at the center temperature sensor; and
- controlling coolant-pumping means that are arranged for injecting a coolant into the cooling circuit, using measured temperature values which are delivered by the outer temperature sensor as a feedback signal, so that the control temperature time-profile is achieved at the outer temperature sensor during steps /2/ and /3/.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2024/081755

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