

Description

This invention relates to the manufacture of contact lenses by cast moulding technology, and in particular to disposable plastics material moulds for casting contact lenses.

Contact lenses are traditionally manufactured by several means including "lathing", "spin casting" and "cast moulding". Each of the above methods possesses advantages in terms of the cost of production of lenses or the variety of lens designs and materials which may be produced. Cast moulding offers significant advantages in respect of relatively low cost of capital plant employed in the production process as well as low unit cost of production while being utilisable over a wide range of polymeric materials.

Present methods of cast moulding described in U.S. Patent No. 4,208,364 (Shepherd) and U.S. Patent No. 4,284,399 (assigned to American Optical Corporation) suffer in practice from relatively low production yields due to defects in or originating from the edge of the cast lens, and in the case of the method described in U.S. Patent No. 4,209,289 (assigned to American Optical Corporation), from numerous instances of poor optical quality.

U.S. 4,208,364 (Shepherd) teaches the casting of a lens between two disposable plastic mould members one of which is provided with a deformable lip which facilitates the relative movement of the mould members towards each other in order to compensate for the shrinkage of the lens polymer which occurs during polymerisation. Said movement maintains contact between the optical surfaces of the mould members and the lens polymer thus ensuring good optical quality of the lens. However, said deformable lip against which the edge of the lens is formed, being of a disadvantageous cross-sectional form and minute dimensions, is difficult to produce to the required degree of precision by the specified injection moulding process.

The resulting lens edges frequently exhibit imperfections which may become more pronounced during the process of removing the formed lens from the assembled mould members. Such imperfections existing in the edge of the lens often cause the lens to be judged as unfit for use. In addition, such imperfections often form sites for the initiation of cracks which may propagate into the lens providing further cause for rejection of the lens on inspection.

A further limitation of the method taught in the Shepherd patent results from variable deformation of the described flexible lip which in turn results in variation of the edge thickness around the lens and, at times, in unacceptable variation in the lens centre thickness.

As a result of the above deficiencies, the production yield of lenses manufactured by the Shepherd method, being the number of lenses produced from a

given number of cast mouldings, is generally of the order of 50% or less.

The method described in U.S. Patent No. 4,284,399 (assigned to American Optical Corporation) does not provide a means for the mould members to move towards each other during polymerisation other than by deformation of the surfaces of the mould members, which appears to be assisted by the loading of the assembled members with a weight of "two to three pounds". The deformation of the surfaces of the mould members can be expected to result in loss of optical quality in the moulded lens.

The method can further suffer from imperfections in the lens edge which is formed against the junction line between the two mould members. Misalignment of the mould members on assembly of the members prior to polymerisation of the lens forming monomer may occur due to variation in the actual size of the mould members produced from given tooling at different times. Any such misalignment will result in a deformation of the lens edge.

A further limitation of the method described in the American Optical patent lies in the fact that the configuration of the portion of the female mould member at the point where the edge is formed against such member, being of disadvantageous cross-sectional form and minute dimensions, does not lend itself to production by the injection moulding process specified in the patent. The lens edge form shown in the patent could not therefore be effectively moulded without deformation resulting from imperfections in the said portion of the female mould member.

It is an object of the present invention to overcome the described edge-related problems by providing a mould and a method which will result in an acceptable edge form while at the same time providing a means for the mould members to move towards each other in order to compensate for shrinkage which occurs during the polymerization of the lens forming monomer.

A further object of the invention is to provide a configuration for the respective mould members which can be readily moulded by a conventional injection moulding process such that the lens edge form described may be reliably achieved utilizing the said mould members.

The above-mentioned US-A-4208364 describes a plastics material mould for casting a contact lens from curable material which shrinks during curing, said mould comprising:

male and female mould members adapted to fit together to define a mould cavity; and

said male and female mould members each present a curved surface for moulding a respective desired optical surface of a contact lens;

said male and female mould members being adapted to permit the mould members to move towards one another during curing of said curable ma-

terial introduced into the mould cavity to cast a lens.

The present invention is characterized in that:

said male mould member has a shoulder adjacent and circumferentially surrounding its optical curved surface;

said female mould member presents a generally cylindrical surface adjacent and circumferentially surrounding its optical curved surface; and

said shoulder is a circumferentially continuous slidable fit with said generally cylindrical surface when the mould members are assembled to permit the mould members to move slidably towards one another during curing of said curable material introduced into the mould cavity to cast a lens.

In another aspect the invention provides a method as set forth in claim 11.

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1a is a vertical section through the prior art Shepherd mould;

Figure 1b is an enlarged fragmentary view of an edge portion of the Shepherd mould;

Figure 2a is a vertical section through the prior art American Optical mould;

Figure 2b is an enlarged fragmentary view of an idealized edge portion in that mould;

Figure 2c is an enlarged fragmentary view of an actual edge portion of that mould;

Figure 3a is a vertical section through a mould according to the present invention;

Figure 3b is an enlarged fragmentary view of an edge portion of the mould of Figure 3a;

Figure 4 is a vertical section through a second embodiment of a mould according to the invention adapted for mounting on a lathing machine; and

Figure 5 is a vertical section through a third embodiment of a mould according to the present invention.

Figures 1a and 1b show the prior art Shepherd mould having male and female mould members 10,11 the male member having a deformable lip 12. The practical disadvantages of this arrangement have been described above, in particular that the deformable lip 12, against which the edge of the lens is formed, is of disadvantageous cross-sectional form and minute dimensions.

Figures 2a to 2c show the prior art American Optical mould having male and female mould members 15,16 provided with abutting annular seats 17,18. The practical disadvantages of this arrangement have been described above, in particular that the seats 17,18 do not provide means for the mould members to move towards each other during polymerisation other than by deformation of the mould members. In addition the seat portion 18 of the female member, against which the edge of the lens is formed, is again

of disadvantageous cross-sectional form and minute dimensions. While Figure 2b shows an idealised shape, in practice the shape tends to be variable and more as shown in Figure 2c.

Figures 3a and 3b show an embodiment of the present invention. A mould member 20 having a convex optical surface 21 is generally referred to as the male mould member and the base curve of the cast contact lens is formed against the optical surface 21. A mould member 22 having a concave optical surface 23 is generally referred to as the female mould member and the anterior surface of the cast contact lens is formed against the optical surface 23. The male and female mould members fit together to define a mould cavity 24 within which the lens is cast.

The mould members 20,22 may conveniently be manufactured by an injection moulding process using a thermo-moulding polymer such as poly-propylene.

The female mould member 22 is provided with a generally cylindrical surface 25 which may be a right circular cylindrical surface or which may advantageously be of a frusto-conical form (as shown in Figs. 3a and 3b) so as to provide a lead-in for the opposing shoulder of the male mould member 20 which mates with the said cylindrical surface 25 of the female mould member upon assembly of the mould members prior to polymerisation of the lens monomer. The male mould member is provided with a shoulder 26 surrounding its optical curved surface 21. The shoulder presents a substantially right-angled corner formed by the junction of a first annular surface 27 facing the female mould member and a second right circular cylindrical surface 28.

The female mould member 22 is assembled with the male mould member 20 after first being charged with a metered dose of monomeric material from which the contact lens will be formed by polymerisation. Polymerisation of the monomeric material is then effected by heating the assembly in a waterbath or temperature-controlled oven or by other means familiar to those skilled in the art such as ultra-violet radiation in which case at least one of the mould members must be formed from a material which is transparent or semi-transparent to such radiation.

The edge 29 of the lens is formed between the surface 27 of the shoulder 26 of the male mould and a portion of the cylindrical or frusto-conical surface 25 of the female mould as shown in Fig. 3b. The engagement of the corner at the junction between the surfaces 27 and 28 of the shoulder of the male mould member against the surface 25 of the female mould member provides a running seal between the two members through which excess monomeric material may escape from the cavity contained between the two mould members during the progressive assembly of the members.

During polymerisation of the monomeric lens-forming material the male and female mould mem-

bers may approach each other as the corner junction of surfaces 27 and 28 of the shoulder of the male mould member slides along the surface 25 of the female mould member. The positioning of the male mould member relative to the female mould member upon assembly of the members may be determined by appropriate adjustment of the stroke of the assembling means provided on a machine within or upon which the mould members are assembled.

Alternatively the mould members may be provided with mating flat ring surfaces respectively marked as 30 and 31 in Fig. 3a. In this case a hinging effect which occurs at the intersection of the surfaces 31 and 28 of the male mould member permits the surfaces of the mould members to move towards each other by means of the above described sliding of the shoulder of the male mould member along the cylindrical or frusto-conical surface of the female mould member. The male mould member may if required be weakened as shown at 32 by reduction of the wall thickness in the region of the point of intersection of the surfaces 31 and 28 so as to facilitate the above described hinging effect.

It will be noted that it is not necessary to place any load on the assembly during the polymerisation process. The shrinkage of the monomeric material during polymerisation serves to draw the two optical surfaces together by a combination of atmospheric pressure and adhesion of the respective surfaces of the mould members to the polymerising monomeric material. The above described sliding fit between the surface 25 of the female mould member and the opposing shoulder 26 of the male mould member coupled with the hinging effect between surfaces 28 and 31 of the male mould member minimises the resistance to movement of the mould members towards each other under the influence of atmospheric pressure and or adhesive attachment of the respective surfaces of the mould members to the polymerising monomeric material.

Fig. 3b is an enlarged view of the mould members in the region where the lens edge 29 is formed between the mould members. From this it will be seen that the configuration of each of the mould members in this region is such as to be readily mouldable using conventional injection moulding technology. Narrow and acutely angled cross-sections such as may be found in the region of the lip 12 on the relevant mould member of Shepherd or in the extreme edge 18 of the female mould member of American Optical have been avoided. Both mould members of the present embodiment have relevant cross-sections consisting of right angles or obtuse angles which may be accurately reproduced by conventional injection moulding techniques.

As shown in Fig. 4, the disposable mould members may advantageously be designed incorporating a means 40 for mounting the mould members in their

assembled from onto the rotating spindle 41 of a lathing machine (not shown) which may have cutting tool 42 to remove a portion 43 of the female mould member from the assembly so as to expose the front surface and a portion of the edge of the cast lens 44. After removal of the female mould portion 43 the lens 44 may be easily released from the male mould by distortion of the mould surface which may be achieved by a simple squeezing action applied at the base of the mould assembly.

In another embodiment (not shown) the portion or the female mould may be removed with the lens adhering to such portion from which it may subsequently be detached by a squeezing action applied across the diameter of the removed female mould portion.

The removal of the female mould portion as above described may be advantageously performed on a special purpose machine (not shown) wherein the loading of the mould assembly onto the rotating spindle and the machining of the portion of the female mould are carried out automatically.

The lens edge produced by the above described moulds and methods is of an essentially triangular cross-section with its apex occurring at the approximate mid point of the edge. If a different cross-sectional edge profile is required the moulded edge may be polished by conventional lens edge polishing means or by tumbling the lens utilizing small glass spheres in a manner similar to that used during the production, of intra-ocular lenses.

Figure 5 shows a further embodiment comprising a male mould member 50 and a female mould member 51. The male mould has a convex optical surface 52 and a shoulder 53 similar to shoulder 26 described in relation to Figures 3a and 3b. The female mould has a generally cylindrical surface surrounding its concave optical surface 54. The generally cylindrical surface comprises first, second and third surfaces in succession away from the optical surface 54. The first surface is a frusto-conical surface 55 tapering outwardly at a taper angle preferably in the range of from 5 to 10°, for providing the slidable fit with the shoulder 53 of the male member as described in relation to Figure 3a and 3b. The second surface is substantially a right circular cylindrical surface 56 to improve seating of the mould members together upon assembly. The third surface is a frusto-conical surface 57 tapering outwardly away from the optical surface.

The mould members are provided with opposing planar ring surface portions 58 and 59 similar to ring surface portions 30 and 31 in Figure 3a and for a similar purpose. The female mould member has a further cylindrical portion 60 outwardly of the ring portion 59, and the inner surface 61 of portion 60 is slightly roughened. The ring portion 58 of the male member has an annular groove 62 close to its outer edge to

produce an annular resilient beak 63 dimensioned to be a resilient fit within the roughened cylindrical portion 60. Accordingly, the beak and the roughened portion provide a locking or ratchet effect as the male member moves towards the female member during assembly of the mould members and during subsequent curing. This embodiment is particularly suitable for the casting of lenses from monomer mixtures with highly volatile components, when the moulds must be relatively firmly sealed together. During curing the male mould member can travel towards the female member to compensate for monomer shrinkage, as with the earlier described embodiments.

Claims

1. A plastics material mould for casting a contact lens from curable material which shrinks during curing, said mould comprising:

male and female mould members (20,22;50,51) adapted to fit together to define a mould cavity; and

said male and female mould members each present a curved surface (21,23;52,54) for moulding a respective desired optical surface of a contact lens;

said male and female mould members being adapted to permit the mould members to move towards one another during curing of said curable material introduced into the mould cavity to cast a lens;

characterized in that:

said male mould member (20,50) has a shoulder (26,53) adjacent and circumferentially surrounding its optical curved surface;

said female mould member (22,51) presents a generally cylindrical surface (25,55) adjacent and circumferentially surrounding its optical curved surface; and

said shoulder (26,53) is a circumferentially continuous slidable fit with said generally cylindrical surface (25,55) when the mould members are assembled to permit the mould members to move slidably towards one another during curing of said curable material introduced into the mould cavity to cast a lens.

2. A mould according to claim 1 characterized in that said shoulder (26,53) presents a substantially right-angled external corner in any cross-section around its circumference.

3. A mould according to claim 2 characterized in that said shoulder (26,53) of said male mould member presents a first planar annular surface (27) perpendicular to the lens axis and facing the female mould member, and a second right circular cylindrical surface (28), said external corner being formed by the junction of said first and second surfaces (27,28).

drical surface (28), said external corner being formed by the junction of said first and second surfaces (27,28).

4. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface (25,55) of said female mould member is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member at a taper angle of up to substantially 10°.

5. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface of said female mould member is substantially a right circular cylindrical surface.

6. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface of said female mould member (51) comprises first, second and third surfaces (55,56,57) in succession away from the optical curved surface of the female mould member,

said first surface (55) is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member at a taper angle of up to substantially 10°, for providing said slidable fit with the shoulder (53) of the male mould member,

said second surface (56) is substantially a right circular cylindrical surface to improve sealing of the mould members together upon assembly, and

said third surface (57) is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member.

7. A mould according to any one of claims 1 to 6 characterized in that said male and female mould members (20,22;50,51) are provided with opposing planar ring surface portions (30,31;58,59) disposed outwardly of the slidable fit region, said opposing planar ring surface portions seating against one another when the mould members are assembled for curing the curable material to cast a lens.

8. A mould according to claim 7 characterized in that the planar ring surface portion (31) of the male member (20) is adapted to create a circumferential hinge zone (32) about which the surface portion can move pivotally to permit said relative movement of the mould members during curing.

9. A mould according to any one of claims 1 to 8 characterized in that said male and female mould members (50,51) are provided one each with a circumferential roughened or ratchet surface (61)



produce an annular resilient beak 63 dimensioned to be a resilient fit within the roughened cylindrical portion 60. Accordingly, the beak and the roughened portion provide a locking or ratchet effect as the male member moves towards the female member during assembly of the mould members and during subsequent curing. This embodiment is particularly suitable for the casting of lenses from monomer mixtures with highly volatile components, when the moulds must be relatively firmly sealed together. During curing the male mould member can travel towards the female member to compensate for monomer shrinkage, as with the earlier described embodiments.

Claims

1. A plastics material mould for casting a contact lens from curable material which shrinks during curing, said mould comprising:

male and female mould members (20,22;50,51) adapted to fit together to define a mould cavity; and

said male and female mould members each present a curved surface (21,23;52,54) for moulding a respective desired optical surface of a contact lens;

said male and female mould members being adapted to permit the mould members to move towards one another during curing of said curable material introduced into the mould cavity to cast a lens;

characterized in that:

said male mould member (20,50) has a shoulder (26,53) adjacent and circumferentially surrounding its optical curved surface;

said female mould member (22,51) presents a generally cylindrical surface (25,55) adjacent and circumferentially surrounding its optical curved surface; and

said shoulder (26,53) is a circumferentially continuous slidable fit with said generally cylindrical surface (25,55) when the mould members are assembled to permit the mould members to move slidably towards one another during curing of said curable material introduced into the mould cavity to cast a lens.

2. A mould according to claim 1 characterized in that said shoulder (26,53) presents a substantially right-angled external corner in any cross-section around its circumference.

3. A mould according to claim 2 characterized in that said shoulder (26,53) of said male mould member presents a first planar annular surface (27) perpendicular to the lens axis and facing the female mould member, and a second right circular cylindrical surface (28), said external corner being formed by the junction of said first and second surfaces (27,28).

4. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface (25,55) of said female mould member is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member at a taper angle of up to substantially 10°.

5. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface of said female mould member is substantially a right circular cylindrical surface.

6. A mould according to any one of claims 1 to 3 characterized in that said generally cylindrical surface of said female mould member (51) comprises first, second and third surfaces (55,56,57) in succession away from the optical curved surface of the female mould member,

said first surface (55) is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member at a taper angle of up to substantially 10°, for providing said slidable fit with the shoulder (53) of the male mould member,

said second surface (56) is substantially a right circular cylindrical surface to improve sealing of the mould members together upon assembly, and

said third surface (57) is a frusto-conical surface tapering outwardly away from the optical curved surface of the female mould member.

7. A mould according to any one of claims 1 to 6 characterized in that said male and female mould members (20,22;50,51) are provided with opposing planar ring surface portions (30,31;58,59) disposed outwardly of the slidable fit region, said opposing planar ring surface portions seating against one another when the mould members are assembled for curing the curable material to cast a lens.

8. A mould according to claim 7 characterized in that the planar ring surface portion (31) of the male member (20) is adapted to create a circumferential hinge zone (32) about which the surface portion can move pivotally to permit said relative movement of the mould members during curing.

9. A mould according to any one of claims 1 to 8 characterized in that said male and female mould members (50,51) are provided one each with a circumferential roughened or ratchet surface (61)



and a circumferential resilient beak (63) disposed outwardly of the slidable fit region, whereby the beak (63) and said surface (61) engage one another to tend to lock the mould members together when they are assembled for curing the curable material to cast a lens.

10. A mould according to any one of claims 1 to 9 characterized in that said mould members are provided with integral means (40) for mounting the assembled mould members onto the spindle (41) of a lathing machine.

11. A method of casting a contact lens from curable material which shrinks during curing, said method comprising :

providing disposable male and female mould members (20,22;50,51) which fit together to define a mould cavity and each present a curved surface (21,23;52,54) for moulding a respective desired optical surface of the contact lens;

charging the female mould member with a predetermined dose of monomeric material;

assembling the charged female member with the male member;

curing the monomeric material while permitting the mould members to move towards one another; and

removing the cast lens from the mould members;

characterized by:

providing said male mould member (20,50) with a shoulder (26,53) adjacent and circumferentially surrounding its optical curved surface;

providing said female mould member (22,51) with a generally cylindrical surface (25,55) adjacent and circumferentially surrounding its optical curved surface;

said assembling step comprises assembling the charged female member with the male member with the shoulder (26,53) being a circumferentially continuous slidable fit with the generally cylindrical surface (25,55); and

said curing step permitting the mould members to slide towards one another during curing.

Patentansprüche

1. Gießform zur Herstellung von Kontaktlinsen aus einem härtbaren Material, welches während der Abhärtung einem Schrumpfvorgang ausgesetzt ist, bestehend aus zwei Formhälften (20,22; 50,51), welche unter Bildung eines Formhohlraumes ineinander steckbar sind, wobei die beiden

Formhälften jeweils gekrümmte Oberflächen (21,23; 52,54) aufweisen, mit welchen die optischen Oberflächen einer Kontaktlinse formbar sind, und wobei die beiden Formhälften derart ausgelegt sind, daß dieselben während der Härtung des in den Formhohlraum eingebrachten härtbaren Materials zur Formung einer Kontaktlinse gegeneinander bewegbar sind, dadurch gekennzeichnet, daß die innere Formhälfte (20,50) eine Ringschulter (26,53) aufweist, welche die jeweilige optische Oberfläche umfänglich umgibt, während die äußere Formhälfte (22,51) eine im wesentlichen zylindrische Oberfläche (25,55) besitzt, welche ebenfalls die optisch gekrümmte Oberfläche umgibt, so daß beim Zusammenstecken der beiden Formhälften die Ringschulter (26,53) entlang ihres Umfangs einen kontinuierlichen Gleitkontakt gegenüber der im wesentlichen zylindrischen Oberfläche (25,55) bildet, damit während des Abhärtvorgangs des in den Formhohlraum zur Herstellung der Kontaktlinse eingegebenen härtbaren Materials eine Bewegung zueinander stattfinden kann.

2. Gießform nach Anspruch 1, dadurch gekennzeichnet, daß die Ringschulter (26,53) entlang ihres Umfangs eine im wesentlichen rechtwinklige äußere Ecke aufweist.

3. Gießform nach Anspruch 2 dadurch gekennzeichnet, daß die Ringschulter (26,53) der inneren Formhälfte eine erste senkrecht zu der Linsenachse stehende und in Richtung der äußeren Formhälfte führende Ringfläche (27) und eine zweite zylindrische Oberfläche (28) aufweist, wobei die äußere Ecke durch die Verbindungslinie dieser beiden Oberflächen (27,28) gebildet ist.

4. Gießform nach einem der Ansprüche 1 bis 3 dadurch gekennzeichnet, daß die im wesentlichen zylindrische Oberfläche (25,55) der äußeren Formhälfte eine kegelstumpfförmige Oberfläche ist, welche von der optisch gekrümmten Oberfläche der äußeren Formhälfte unter einem Neigungswinkel bis zu 10° nach außen führt.

5. Gießform nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die im wesentlichen zylindrische Oberfläche der äußeren Formhälfte eine kreisförmige Zylinderoberfläche ist.

6. Gießform nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die im wesentlichen zylindrische Oberfläche der äußeren Formhälfte (51) anschließend an die optisch gekrümmte Oberfläche der äußeren Formhälfte drei anein-



anderschließende Oberflächenbereiche (55-57) aufweist, wobei der erste Oberflächenbereich (55) eine kegelstumpfförmige Oberfläche ist, welche von der optisch gekrümmten Oberfläche der äußeren Formhälfte unter einem Neigungswinkel bis zu 10° nach außen geneigt ist, um auf diese Weise einen Gleitkontakt gegenüber der Ringschulter (53) der inneren Formhälfte zu bilden, wobei ferner der zweite Oberflächenbereich (56) eine im wesentlichen kreisförmige Zylinderoberfläche ist, mit welcher die Abdichtung der Formhälften untereinander im zusammengebauten Zustand verbessert wird, während der dritte Oberflächenbereich (57) eine kegelstumpfförmige Oberfläche ist, welche von der optisch gekrümmten Oberfläche der äußeren Formhälfte nach außen geneigt ist.

7. Gießform nach einem der Ansprüche 1 bis 6 dadurch gekennzeichnet, daß die beiden Formhälften (20,22; 50,51) mit gegenüberliegenden flachen Ringbereichen (30,31; 58,59) versehen sind, welche von dem verschiebbaren Kontaktbereich nach außen führen und welche im zusammengebauten Zustand der Formhälften während der Abhärtung des härtbaren Materials bei der Herstellung der Kontaktlinse aufeinander zu liegen gelangen.
8. Gießform nach Anspruch 7, dadurch gekennzeichnet, daß der flache Ringbereich (31) der inneren Formhälfte (20) einen in Umfangsrichtung wirksamen Scharnierbereich (22) besitzt, um welchen der Oberflächenbereich schwenkbar bewegbar ist, so daß eine relative Bewegung der Formhälften während der Abhärtung möglich ist.
9. Gießform nach einem der Ansprüche 1-8 dadurch gekennzeichnet, daß die beiden Formhälften (50,51) in Umfangsrichtung jeweils mit einer aufgerauhten bzw. verzahnten Oberfläche (61) bzw. einem elastischen äußeren Ringbereich (63) außerhalb des Bereiches des verschiebbaren Kontaktes versehen sind, wobei der elastische äußere Ringbereich (63) und die Oberfläche (61) miteinander in Eingriff gelangen, so daß die beiden Formhälften im zusammengebauten Zustand während der Abhärtung des härtbaren Materials zur Herstellung einer Kontaktlinse gegeneinander verriegelt sind.
10. Gießform nach einem der Ansprüche 1-9 dadurch gekennzeichnet, daß die Formhälften mit einem Ansatz (40) versehen sind, welcher eine Befestigung der zusammengesetzten Formhälften auf dem Dorn (41) einer Drehbank gestatten.
11. Verfahren zur Formung einer Kontaktlinse aus

härtbaren Material, welches während der Abhärtung einem Schrumpfvorgang ausgesetzt ist, bei welchem im Einwegverfahren verwendbare Formhälften (20,22; 50,51) vorgesehen sind, durch welche ein Formhohlraum umschlossen wird, und welche jeweils gekrümmte Oberflächen (20,23; 52,54) aufweisen, um auf diese Weise die entsprechenden optischen Oberflächen einer Kontaktlinse zu formen; bei welchem ferner in die äußere Formhälfte eine vorgegebene Menge eines monomerischen Materials eingebracht wird; bei welchem in die eingefüllte äußere Formhälfte die innere Formhälfte eingesetzt wird; bei welchem das monomerische Material bei gleichzeitiger Bewegbarkeit der Formhälften untereinander zur Auswertung gelangt und bei welcher eine Entfernung der hergestellten Kontaktlinse aus den Formhälften erfolgt dadurch gekennzeichnet, daß die innere Formhälfte (20,50) im Umfangsbereich der optisch gekrümmten Oberfläche mit einer Schulter (26,53) versehen wird, während die äußere Formhälfte (22,51) im Umfangsbereich der optisch gekrümmten Oberfläche eine im wesentlichen zylindrische Oberfläche (25,55) besitzt; daß beim Zusammensetzen der mit Formgut versehenen äußeren Formhälfte in die jeweils eine Schulter (26,53) aufweisende innere Formhälfte ein entlang des Umfangs sich ergebender kontinuierlicher Gleitkontakt gegenüber der im wesentlichen zylindrischen Oberfläche (25,55) gebildet wird, und daß bei der Abhärtung die beiden Formhälften gegeneinander zum Gleiten gebracht werden.

Revendications

1. Moule en matière plastique, destinée à la coulée d'une lentille de contact au départ d'une matière durcissable qui se contracte durant le durcissement, ce moule comprenant :
des éléments de moule mâle et femelle (20, 22 ; 50, 51) destinés à s'adapter l'un à l'autre pour former une cavité de moule ;
ces éléments de moule mâle et femelle présentant chacun une surface courbe (21, 23 ; 52, 54) pour le moulage d'une surface optique désirée correspondante d'une lentille de contact ;
ces éléments de moule mâle et femelle étant adaptés pour leur permettre un déplacement l'un vers l'autre durant le durcissement de la matière durcissable précitée, introduite dans la cavité de moule en vue de la coulée d'une lentille ;
caractérisé en ce que :
l'élément de moule mâle précité (20, 50) comporte un épaulement (26, 53) adjacent à sa surface courbe optique et entourant la circonfé-



rence de celle-ci;

l'élément de moule femelle précité (22, 51) présente une surface d'allure générale cylindrique (25, 55) adjacente à sa surface courbe optique et entourant la circonférence de celle-ci;

l'épaulement précité (26, 53) forme un montage pouvant glisser, continu suivant la circonférence, avec la surface d'allure générale cylindrique précitée (25, 55) lorsque les éléments de moule sont assemblés, pour permettre à ces éléments de se déplacer à glissement l'un vers l'autre durant le durcissement de la matière durcissable précitée, introduite dans la cavité de moule pour la coulée d'une lentille.

2. Moule suivant la revendication 1, caractérisé en ce que l'épaulement précité (26, 53) présente un coin extérieur essentiellement à angle droit, dans toute section transversale quelconque de sa circonférence.
3. Moule suivant la revendication 2, caractérisé en ce que l'épaulement précité (26, 53) de l'élément de moule mâle présente une première surface annulaire plane (27) perpendiculaire à l'axe de symétrie de la lentille et faisant face à l'élément de moule femelle, et une seconde surface en forme de cylindre circulaire droit (28), le coin extérieur précité étant formé par la jonction entre la première et la seconde surface (27, 28).
4. Moule suivant l'une quelconque des revendications 1 à 3, caractérisé en ce que la surface d'allure générale cylindrique précitée (25, 55) de l'élément de moule femelle est une surface tronconique s'évasant vers l'extérieur depuis la surface courbe optique de l'élément de moule femelle suivant un angle de conicité allant jusqu'à environ 10°.
5. Moule suivant l'une quelconque des revendications 1 à 3, caractérisé en ce que la surface d'allure générale cylindrique susdite de l'élément de moule femelle est essentiellement une surface en forme de cylindre circulaire droit.
6. Moule suivant l'une quelconque des revendications 1 à 3, caractérisé en ce que la surface d'allure générale cylindrique précitée de l'élément de moule femelle (51) comprend une première, une seconde et une troisième surface (55, 56, 57), et ce successivement depuis la surface courbe optique de l'élément de moule femelle, la première surface précitée (55) est une surface tronconique s'évasant vers l'extérieur depuis la surface courbe optique de l'élément de moule femelle suivant un angle de conicité allant essentiellement jusqu'à 10°, pour former le mon-

tage glissant précité avec l'épaulement (53) de l'élément de moule mâle,

la seconde surface susdite (56) est essentiellement une surface en forme de cylindre circulaire droit pour améliorer le scellage des éléments de moule ensemble lors de leur assemblage, et

la troisième surface précitée (57) est une surface tronconique s'évasant vers l'extérieur depuis la surface courbe optique de l'élément de moule femelle.

7. Moule suivant l'une quelconque des revendications 1 à 6, caractérisé en ce que les éléments de moule mâle et femelle précités (20, 22 ; 50, 51) comportent des portions superficielles annulaires planes opposées (30, 31 ; 58, 59) disposées à l'extérieur de la zone à montage glissant, ces portions superficielles annulaires planes opposées s'appuyant l'une contre l'autre lorsque les éléments de moule sont assemblés pour le durcissement de la matière durcissable en vue de la coulée d'une lentille.
8. Moule suivant la revendication 7, caractérisé en ce que la portion superficielle annulaire plane (31) de l'élément mâle (20) est destinée à créer une zone circonférentielle formant charnière (32), autour de laquelle la portion superficielle peut se déplacer à pivotement pour permettre le déplacement relatif susdit des éléments de moule durant le durcissement.
9. Moule suivant l'une quelconque des revendications 1 à 8, caractérisé en ce que les éléments de moule mâle et femelle (50, 51) comportent chacun une surface circonférentielle rendue rugueuse ou surface d'encliquetage (61) et un bec résilient circonférentiel (63) disposé extérieurement à la région à montage glissant, de sorte que ce bec (63) et cette surface (61) coopèrent l'un avec l'autre pour tendre à bloquer ensemble les éléments de moule, lorsqu'ils sont assemblés en vue du durcissement de la matière durcissable dans la coulée d'une lentille.
10. Moule suivant l'une quelconque des revendications 1 à 9, caractérisé en ce que les éléments de moule susdits comportent des moyens en faisant partie (40) pour le montage des éléments de moule assemblés sur l'axe (41) d'une machine de tournage.
11. Procédé pour couler une lentille de contact au départ d'une matière durcissable qui se contracte durant le durcissement, ce procédé comprenant: la prévision d'éléments de moule mâle et femelle sacrificiables (20, 22 ; 50, 51) qui s'adaptent l'un à l'autre pour former une cavité de moule



et qui présentent chacun une surface courbe (21, 23 ; 52, 54) pour le moulage d'une surface optique désirée correspondante de la lentille de contact ;

le chargement de l'élément de moule femelle par une dose prédéterminée de matière monomère ; 5

l'assemblage de l'élément femelle chargé avec l'élément mâle ;

le durcissement de la matière monomère, tout en permettant aux éléments de moule de se déplacer l'un vers l'autre ; et 10

l'enlèvement de la lentille coulée hors des éléments de moule ;

caractérisé par : 15

la prévision sur l'élément de moule mâle précité (20, 50) d'un épaulement (26, 53) adjacent à sa surface courbe optique et entourant la circonférence de celle-ci;

la prévision sur l'élément de moule femelle précité (22, 51) d'une surface d'allure générale cylindrique (25, 55) adjacente à sa surface courbe optique et entourant la circonférence de celle-ci ; 20

la phase d'assemblage précitée comprend l'assemblage de l'élément femelle chargé avec l'élément mâle de manière que l'épaulement (26, 53) se situe suivant un montage glissant, continu suivant la circonférence, avec la surface d'allure générale cylindrique (25, 55) ; et 25 30

la phase de durcissement citée permettant aux éléments de moule de glisser l'un vers l'autre durant le durcissement.

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