Claims

1. Apparatus for simultaneously manufacturing a plurality of single-use plastic molds for making ~~ophthalmic lenses such as~~ contact lenses through injection molding, the apparatus comprising:

- an injection molding tool comprising two molding tool halves (1, 2), a first molding tool half (1) and a second molding tool half (2), the first molding tool half (1) having a first surface (10) and the second molding tool half (2) having a second surface (20), the first and second surfaces (10, 20) facing each other and being essentially plane and arranged parallel to each other,

- wherein the first molding tool half (10) comprises a plurality of first molding members (11) which are arranged on the first surface (10),

- and wherein the second molding tool half (2) comprises a corresponding plurality of second molding members (21) which are arranged on the second surface (20) and opposite to the first molding members (11),

- and wherein in a closed position of the two molding tool halves (1, 2) the corresponding first and second molding members (11, 21) of the first and second molding tool halves (1, 2) each define a cavity (4) between them that corresponds in shape to a single-use plastic mold (5) to be manufactured,

and

- a gripper tool (3) comprising a plurality of gripper members (31) corresponding to the plurality of first and second molding members (11, 21),

- wherein the gripper members (31) are arranged on the gripper tool (3) in a manner corresponding to the arrangement of the first and second molding members (11, 21) on the first and second surfaces (10, 20) of the first and second molding tool halves (1, 2),

- and wherein each of the gripper members (31) is configured to allow suction to be applied thereto,

wherein at least one of the first and second molding tool halves (1, 2) is movably arranged relative to the other of the first and second molding tool halves (1, 2) in a direction perpendicular to the first and second surfaces (10, 20), for moving the first and second molding tool halves (1, 2) into a closed position, in which a flowable plastic material can be injected into the cavities (4) defined between the oppositely arranged first and second molding members (11, 21) and cooled to form the demoldable single-use plastic molds

(5), and for moving the first and second molding tool halves (1, 2) into an open position, in which a space is formed between the first and second surfaces (10, 20),

wherein further a front surface of each of the first molding members (11~~, 21~~) comprises at least two recesses (113) which are arranged diametrically opposed relative to a central axis (114) of the respective first molding member (11), with the recesses (113) being arranged in a peripheral portion (111) of the front surface of the respective first molding member (11) that corresponds to a rear surface of a flange portion (511) of the respective single-use plastic mold (5) to be manufactured, the recesses (113) having a conical shape that is tapering in a direction away from the front surface (10) and being configured to allow a ~~the~~ formation of pins (513) projecting from the rear surface of the flange portion (511) of the single-use plastic mold (5) to be manufactured into the recesses (113) in the peripheral portion (111) of the front surface of the first molding member (11) in order to make the single-use plastic mold (5) adhere to the first molding member (11),

and wherein the gripper tool (3) is movably arranged only in a direction parallel to the first surface (10) of the first molding tool half (1) into and out of the space formed between the first and second surfaces (10) of the first and second molding tool halves (1, 2) in the open position, for moving the gripper tool (3) into a transfer position in which the gripper members (31) are arranged opposite of the first molding members (11) so as to be capable of releasing the demoldable single-use plastic molds (5) from first molding members (11) and sucking them against the gripper members (31) to transfer the demoldable single-use plastic molds (5) from the first molding members (11) to the gripper members (31), and for subsequently moving the gripper tool (3) with the single-use plastic molds (5) sucked against the gripper members (31) out of the space formed between the first and second surfaces (10, 20).

2. Apparatus according to claim 1, wherein the front surface of each of the first molding members (11) comprises four recesses (113) which are arranged in the peripheral portion (111) of the front surface, the four recesses (113) being arranged angularly equidistantly from each other when viewed in a circumferential direction.

3. Apparatus according to any one of claims 1 or 2, wherein the recesses (113) in the front surface of the first molding members (11) of the first molding tool half (1) have a depth (116) in a ~~the~~ range of 0.1 mm to 0.5 mm.

4. Apparatus according to any one of claims 1 to 3, wherein the recesses (113) in the front surface of the first molding members (11) of the first molding tool half (1) have a circular cross-section with a diameter in ~~the~~ a range of 0.5 mm to 1.5 mm.

~~5. Apparatus according to any one of claims 1 to 4, wherein the recesses (113) in the front surface of the first molding members (11) of the first molding tool half (1) have a conical shape that is tapering in a direction away from the front surface (10).~~

~~6.~~5. Apparatus according to ~~claim 5~~ any one of claims 1 to 4, wherein a ~~the~~ full cone angle (α) of the conically shaped recesses (113) is in a ~~the~~ range of 0 ~~up~~ to 30 degrees.

~~7.~~6. Method for simultaneously manufacturing a plurality of single-use plastic molds (5) for making ~~ophthalmic lenses such as~~ contact lenses through injection molding using an apparatus according to any one of the preceding claims, the method comprising the steps of:

- moving the first and second molding tool halves (1, 2) into the closed position,

- injecting a flowable plastic material into the cavities (4) defined between the oppositely arranged first and second molding members (11, 21),

- cooling the flowable plastic material in the cavities (4) thereby forming demoldable single-use plastic molds (5) having pins (513) in a flange portion (511) of their rear surface, the pins (513) projecting into the recesses (113) having a conical shape that is tapering in a direction away from the front surface (10) and in the peripheral portion (111) of the front surfaces of the first molding members (11) thereby making the demoldable single-use plastic molds (5) adhere to the first molding members (11),

- moving the two molding tool halves (1, 2) into an open position by moving the first and second molding tool halves (1, 2) away from each other in a direction perpendicular to the first and second surfaces (10, 20) so as to form a space between the first and second surfaces (10, 20),

- moving the gripper tool (3) only in a direction parallel to the first surface (10) of the first molding tool half (1) into the space formed between the first and second surfaces (10, 20) and into a transfer position in which the gripper members (31) of the gripper tool (3) are arranged opposite of the demoldable single-use plastic molds (5) adhering to the first molding members (11),

- transferring the demoldable single-use plastic molds (5) from the first molding members (11) to the gripper members (31) by applying suction to the gripper members (31) of the gripper tool (3) to release the demoldable single-use plastic molds (5) from the first molding members (11) and suck the demoldable single-use plastic molds (5) against the gripper members (31) of the gripper tool (3),

- removing the gripper tool (3) from the transfer position and out of the space formed between the first and second surfaces (10, 20) in the direction parallel to the first surface (10) of the first molding tool half (1), with the single-use plastic molds (5) sucked against the gripper members (31), and

- releasing the single-use plastic molds (5) from the gripper members (31) of the gripper tool (3) by terminating the application of suction to the gripper members (31).

~~8.~~7. Method according to claim~~s 7~~6, wherein ~~the~~ a duration of manufacture of the plurality of single-use plastic molds (5) is ~~five seconds or less, and in particular is~~ in ~~the~~ a range of three to five seconds.