for short duration treatment or to gauge how an individual will react to having the insert placed, for example, will the device cause excessive tearing. Permanent punctal plugs are for long term use and are removable at any time. Permanent punctal plugs are available in various sizes with the largest size that fits providing maximum effectiveness. Permanent punctal plugs are typically made of silicone.

A punctal plug typically includes a body portion sized to pass through a lacrimal punctum and be positioned within a lacrimal canaliculus of the eyelid. The punctal plug also comprises a collarette connected to the body portion and sized to rest on the exterior of the lacrimal punctum. The term lacrimal punctum and lacrimal canaliculus are often utilized interchangeably; however, as used herein, the punctum means the opening and the canaliculus is the passageway or duct-like pathways that lead to the lacrimal sac. If the punctal plug is used to deliver therapeutic agents to the eye, then the body portion may comprise a reservoir for holding the therapeutic agents and the collarette may comprise an opening in communication with the reservoir through which the therapeutic agents are released.

Punctal plugs are small. For example, punctal plugs may be in the range of 0.2 to 0.4 millimeters in diameter and up to 2.0 millimeters in length. Devices so small are inherently more difficult to manufacture than larger devices. More importantly, manufacturing small devices in a repeatable and reliable manner is even more difficult. Accordingly, there exists a need for a micro mold and technology for producing or manufacturing punctal plugs with greater efficiency, even higher quality and higher repeatability than currently utilized technologies.

SUMMARY OF THE INVENTION

WHAT IS CLAIMED IS:

1. An injection molding device comprising:

a cartridge assembly defining a chamber for housing a canister of premixed, one-to-one ratio mixture of thermoset elastomer;

a cold deck nozzle assembly, the cartridge assembly being connected to the cold deck nozzle assembly through a one-way check valve and configured to inject thermoset elastomer from the canister into the cold deck nozzle assembly, the cold deck nozzle assembly comprising a manifold block with an internal passageway in fluid communication with the cartridge assembly and adapted to receive thermoset elastomer therefrom, and a cold deck nozzle in fluid communication with the internal passageway; and

a micro plunger injection assembly connected directly to the cold deck nozzle assembly, the micro plunger injection assembly comprising a housing and a plunger moveable therein, the plunger configured to drive the thermoset elastomer through the internal passageway of the cold deck nozzle assembly and the cold deck nozzle, wherein the thermoset elastomer displacement for a single shot is substantially equal to the desired shot weight.

2. The injection molding device according to claim 1, wherein the chamber of the cartridge assembly comprises a substantially tubular member having a removable section for at least one of insertion or removal of the canister.

3. The injection molding deice according to claim 2, herein the cartridge assembly further comprises a mechanism for driving the thermoset elastomer into the cold deck nozzle assembly.

4. The injection molding device according to claim 3, wherein the cold deck nozzle assembly further comprises a nozzle holding base, a cold nozzle holding block, and a chilling mechanism, wherein the nozzle holding base and the cold nozzle holding block secure the cold deck nozzle in position and allow

for fluid communication between the cold deck nozzle and the internal passageway of the manifold block.

5. The injection molding device according to claim 4, wherein the chilling mechanism comprises a series of passageways for circulating cooling water.

6. The injection molding device according to claim 5, wherein the micro plunger injection assembly further comprises a plunger seal pack operatively associated with the plunger and an arrangement for moving the plunger to drive the thermoset elastomer through the internal passageway of the cold deck nozzle assembly and the cold deck nozzle and to a recharge position.

7. The injection molding device according to claim 6, wherein the micro plunger injection unit further comprises a shot stroke adjustment mechanism for setting the stroke length for a given shot.

8. The injection molding device according to claim 7, wherein the cold deck nozzle comprises a valve to open and close the cold deck nozzle.

9. The injection molding device according to claim 1, wherein the device further comprise a control system for controlling the operation of at least one of the cartridge assembly, the cold deck nozzle assembly and the micro plunger injection assembly.

10. A method for injection molding a component, the method comprising:

moving a premixed, one-to-one ratio mixture of thermoset elastomer from a cartridge assembly securing a canister of the thermoset elastomer into an internal passage of a cold deck nozzle assembly; and

driving the thermoset elastomer through the internal passageway of the cold deck nozzle assembly and a cold deck nozzle, wherein the thermoset elastomer displacement for a single shot is substantially equal to the desired shot weight of the component.

for short duration treatment or to gauge how an individual will react to having the insert placed, for example, will the device cause excessive tearing. Permanent punctal plugs are for long term use and are removable at any time. Permanent punctal plugs are available in various sizes with the largest size that fits providing maximum effectiveness. Permanent punctal plugs are typically made of silicone.

A punctal plug typically includes a body portion sized to pass through a lacrimal punctum and be positioned within a lacrimal canaliculus of the eyelid. The punctal plug also comprises a collarette connected to the body portion and sized to rest on the exterior of the lacrimal punctum. The term lacrimal punctum and lacrimal canaliculus are often utilized interchangeably; however, as used herein, the punctum means the opening and the canaliculus is the passageway or duct-like pathways that lead to the lacrimal sac. If the punctal plug is used to deliver therapeutic agents to the eye, then the body portion may comprise a reservoir for holding the therapeutic agents and the collarette may comprise an opening in communication with the reservoir through which the therapeutic agents are released.

Punctal plugs are small. For example, punctal plugs may be in the range of 0.2 to 0.4 millimeters in diameter and up to 2.0 millimeters in length. Devices so small are inherently more difficult to manufacture than larger devices. More importantly, manufacturing small devices in a repeatable and reliable manner is even more difficult. Accordingly, there exists a need for a micro mold and technology for producing or manufacturing punctal plugs with greater efficiency, even higher quality and higher repeatability than currently utilized technologies.

Devices to fabricate small items such as punctual plugs are also known for example DE 102005046032 is a device comprising three canisters designed to hold three components which are added to the body of an injection molding device where they are mixed prior to passing through a cold deck nozzle assembly prior to passing into a mold. US 5229144 is an injection molding apparatus used to make larger components and comprises a fluid jacketed single canister enabling temperature control of the canister.

SUMMARY OF THE INVENTION

CLAIMS:

1. An injection molding device comprising:

a cartridge assembly defining a chamber for housing a canister of premixed, one-to-one ratio mixture able to form a thermoset elastomer;

a cold deck nozzle assembly, the cartridge assembly being directly connected to the cold deck nozzle assembly through a one-way check valve and configured to inject mixture from the canister into the cold deck nozzle assembly, the cold deck nozzle assembly comprising a manifold block with an internal passageway in fluid communication with the cartridge assembly and adapted to receive mixture therefrom, and a cold deck nozzle in fluid communication with the internal passageway; and

a micro plunger injection assembly connected directly to the cold deck nozzle assembly, the micro plunger injection assembly comprising a housing and a plunger moveable therein, the plunger configured to drive mixture through the internal passageway of the cold deck nozzle assembly and the cold deck nozzle, wherein the mixture displacement for a single shot is substantially equal to the desired shot weight.

2. The injection molding device according to claim 1, wherein the chamber of the cartridge assembly comprises a tubular member having a removable section for at least one of insertion or removal of the canister.

3. The injection molding deice according to claim 2, wherein the cartridge assembly further comprises a mechanism for driving mixture into the cold deck nozzle assembly.

4. The injection molding device according to claim 3, wherein the cold deck nozzle assembly further comprises a nozzle holding base, a cold nozzle holding block, and a chilling mechanism, wherein the nozzle holding base and the cold nozzle holding block secure the cold deck nozzle in position and allow for fluid communication between the cold deck nozzle and the internal passageway of the manifold block.

5. The injection molding device according to claim 4, wherein the chilling mechanism comprises a series of passageways for circulating cooling water.

6. The injection molding device according to claim 5, wherein the micro plunger injection assembly further comprises a plunger seal pack operatively associated with the plunger and an arrangement for moving the plunger to drive mixture through the internal passageway of the cold deck nozzle assembly and the cold deck nozzle and to a recharge position.

7. The injection molding device according to claim 6, wherein the micro plunger injection unit further comprises a shot stroke adjustment mechanism for setting the stroke length for a given shot.

8. The injection molding device according to claim 7, wherein the cold deck nozzle comprises a valve to open and close the cold deck nozzle.

9. The injection molding device according to claim 1, wherein the device further comprise a control system for controlling the operation of at least one of the cartridge assembly, the cold deck nozzle assembly and the micro plunger injection assembly.

10. A method for injection molding a component, the method comprising:

moving a premixed, one-to-one ratio mixture able to form a thermoset elastomer from a cartridge assembly securing a canister of the mixture directly into an internal passage of a cold deck nozzle assembly; and

driving mixture through the internal passageway of the cold deck nozzle assembly and a cold deck nozzle via a micro plunger assembly, wherein the mixture displace-ment for a single shot is equal to the desired shot weight of the component.