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(72) Inventor; and
(71) Applicant : **RYAN, Edwin** [US/US]; 752 Goodrich Avenue, St. Paul, Minnesota 55105 (US).

(74) Agents: **MADDEN, Robert B., USPTO Reg. No. 57,521** et al.; Schwegman, Lundberg & Woessner, P.A., P.O. Box 2938, Minneapolis, Minnesota 55402 (US).

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[Continued on next page]

(54) Title: SUBCONJUNCTIVAL INJECTOR AND METHOD

(57) Abstract: An injection device and method are shown. Devices and methods include a forceps and a needle advancement mechanism to clamp a portion of tissue and control a depth of penetration of the needle between gripping ends of the forceps. An injection device and method are shown where selected components of the injection device such as a syringe and forceps are disposable, while the remaining portions of the injection device are reusable. Devices and methods are shown that utilize micro-needles to control a depth of penetration.

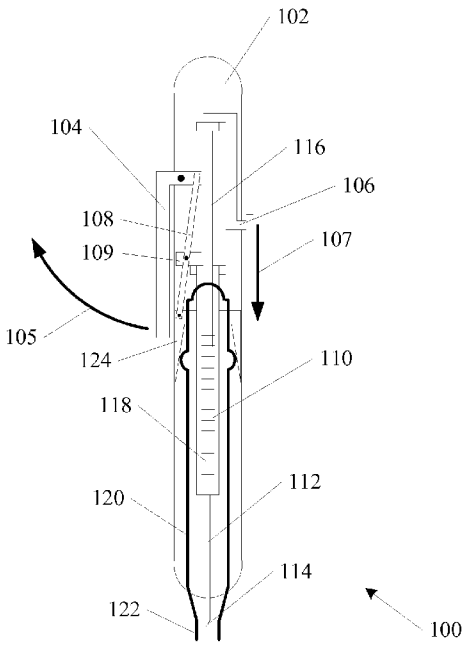

FIG. 1

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SUBCONJUNCTIVAL INJECTOR AND METHOD

Claim of Priority

[001] This application claims the benefit of priority to U.S. Provisional Patent Application No. 61/787,684, filed March 15, 2013, and to U.S. Provisional Patent Application No. 61/935,239, filed February 3, 2014, both of which are incorporated herein by reference in their entireties.

Technical Field

[002] This invention relates to ophthalmological injections.

Background

[003] Ophthalmological injections such as subconjunctival injections are necessary in a number of procedures. It is desirable to increase the repeatability of injection procedures, and to increase the ease of performing injections, and to increase the safety of such injections.

Brief Description of the Drawings

[004] FIG. 1 shows an injection device according to an embodiment of the invention.

[005] FIG. 2 shows the injection device of claim 1 in operation according to an embodiment of the invention.

[006] FIG. 3 shows individual components of an injection device according to an embodiment of the invention.

[007] FIG. 4 shows another injection device according to an embodiment of the invention.

[008] FIG. 5 shows a method of using an injection device according to an embodiment of the invention.

[009] FIG. 6 shows another injection device according to an embodiment of the invention.

[0010] FIG. 7 shows another injection device according to an embodiment of the invention.

Detailed Description

[0011] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is shown, by way of illustration, specific embodiments in which the invention may be practiced. In the drawings, like numerals describe substantially similar components throughout the several views. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments may be utilized and structural, or logical changes, etc. may be made without departing from the scope of the present invention.

[0012] Figure 1 shows an injection device 100 according to an embodiment of the invention. The injection device 100 of Figure 1 includes a body 102 housing a number of additional components. A drug reservoir 118 is shown within the body 102, and a needle 112 connected to the drug reservoir 118. A forceps 120 are also shown within the body 102. A first actuator 104 is operatively coupled to the needle 112. When actuated, the first actuator 104 advances a tip 114 of the needle 112 forward between gripping ends 122 of the forceps 120. A range of travel of the needle 112 is limited by the first actuator 104 and the gripping ends 122 of the forceps 120. In this way, when in use, delivering a drug such as an anesthetic to an eye, the tip 114 of the needle 112 is assured to consistently penetrate the conjunctiva to an effective depth, without penetrating too deep. Although an anesthetic injection is used as an example, injection devices as described in the present disclosure may be used to administer any number of different drugs.

[0013] In the example of Figure 1, the first actuator 104 is moved along arc 105. The motion of the first actuator 104 is translated through a linkage 108, which is coupled to a wedge 124. As the wedge 124 is forced downward, the gripping ends 122 of the forceps 120 are closed. Figure 2 shows the first actuator 104 in operation. The wedge 124 pushes against protrusions 126 on the forceps 120 and causes the gripping ends 122 to close as indicated by arrows 123. A portion 204 of tissue 202, such as a portion of a conjunctiva, is bunched up between the

gripping ends 122. The tip 114 of the needle 112 then penetrates into the portion 204 of tissue 202.

[0014] In the example of Figures 1 and 2, a second linkage 109 is coupled to the first linkage 108 such that in addition to actuating a clamping of the gripping ends 122, the needle 112 is urged in direction 115. In one example, the linkages 108, 109 are timed such that the gripping ends 122 are clamped first, and the needle 112 is urged in direction 115 after the gripping ends 122 are clamped. In one example, the gripping ends 122 and the needle 112 are actuated at the same time.

[0015] In the example shown, the first actuator 104 operates as a single actuator to move both the gripping ends 122 and the needle 112. In other examples, these operations may be performed by separate actuators.

[0016] Although examples of linkages and actuator configurations are shown, the invention is not limited to any one actuation method or type of actuating lever, button, etc. Other linkages and actuators such as pneumatic, hydraulic, electric motor driven operation, solenoid, etc. are within the scope of the invention. Further, other actuators apart from levers may be used without departing from the scope of the invention. For example buttons, knobs or other effective actuators may be used to facilitate gripping of the forceps 120 and controlled motion of the needle 112. In one example one or more of the actuators is electrically powered, and the injection device 100 includes one or more batteries to power the one or more actuators.

[0017] Figure 1 further shows a second actuator 106. In one example, after using the first actuator 104 to grip a portion of tissue, such as a conjunctiva, and advancing the needle 112 into the gripped portion of tissue, the second actuator 106 is moved long direction 107, and is used to expel an amount of a drug into the tissue penetrated by the needle 112. Configurations such as the example shown provide ease of use, in that the tissue is gripped and the needle consistently penetrates to the desired depth using a single control, and the drug is easily delivered when desired using the second control.

[0018] In the configuration shown, the drug reservoir 118 is part of a standard hypodermic syringe 110. The syringe 110 includes a plunger 116 that interacts with the second actuator 106. In one example the syringe 110 is disposable,

while the remaining components of the injection device 100 are reusable. In one example the forceps 120 are disposable, while the remaining components of the injection device 100 are reusable. In one example, both the syringe 110 and the forceps 120 are disposable, while the remaining components of the injection device 100 are reusable.

[0019] Figure 3 illustrates one example where the syringe 110 and forceps 120 may be removed from the body 102 of the injection device 100. In the example shown, the body 102, includes a first portion 304 and a second portion 306 that are hinged 308. In the example shown, the portions 304, 306 are approximately halves of the body 102, although the invention is not so limited. In one example, one portion, such as portion 306 is formed of a substantially clear material, such as clear plastic. When in use, such a configuration allows a user to see if the syringe 110 is full with an appropriate dose of the desired drug.

[0020] An advantage of an example injection device 100 where selected components are removable and disposable includes reduced cost of components, and better ability to sterilize components that will be in contact with a patient. Because a majority of the injection device 100 is reusable, and the cost of elements such as the syringe 110 and forceps 120 that are disposed of are at a minimum, the cost of an injection procedure is reduced. In one example, the forceps are formed from a clear plastic material. Such a configuration reduces cost, and allows the user to better see the tissue where an injection is taking place.

[0021] Figure 4 shows another example injection device 400 according to an embodiment of the invention. In one example, the injection device 400 operates similar to examples described above. A forceps 420 are included, along with a syringe 410. A needle 412 may be advanced using an actuator along with clamping of tissue using the forceps 420. Figure 4 further illustrates a speculum 402 that may be used to hold a patient's eyelids apart during an injection procedure. In one example, the speculum 402 is disposable, while the remaining components of the injection device 400 are reusable. As in examples above, in addition to the speculum 402 being reusable, in one example the syringe 410 is disposable, while the remaining components of the injection device 400 are

reusable. In one example the forceps 420 are disposable, while the remaining components of the injection device 400 are reusable.

[0022] In one example, a light 430 is included at a distal end of the injection device 400. Examples of the light 430 include, but are not limited to an LED light.

[0023] Figure 5 illustrates an example method of use according to an embodiment of the invention. In operation 502, a first control on an injection device is actuated to clamp a forceps on a portion of a conjunctiva and concurrently move a needle into the clamped portion of conjunctiva, wherein a depth of the needle into the conjunctiva is limited by the injection device. In operation 504, a second control on the injection device is actuated to expel an amount of a drug through the needle into the conjunctiva.

[0024] Figure 6 shows another example injection device 600 according to an embodiment of the invention. The injection device 600 includes a forceps handle 610, having a pair of paddles 612 for grasping a conjunctiva of a patient's eye. At least one paddle 612 includes a number of micro-needles 614. In one example, the micro-needles 614 are dimensioned to break a surface of the conjunctiva, but are not long enough to penetrate into any structure beneath. In one example, the micro-needles 614 will penetrate the conjunctiva, but will not penetrate the sclera. In one example, the micro-needles 614 are less than approximately 0.30 mm long. In one example, the micro-needles 614 are less than approximately 0.50 mm long.

[0025] In one example, the injection device 600 includes a drug delivery system 620 that is coupled to the micro-needles 614. The example of Figure 6 shows a reservoir 622 coupled to a tube 624 and an actuator 626. In one example, the actuator 626 includes a piston or plunger that forces a drug from the reservoir 622 through the tube 624 into the micro-needles 614. In one example, the micro-needles 614 are located on only one paddle 612. In one example, both paddles 612 may include micro-needles 614. In one example, the drug that is delivered includes an anesthetic.

[0026] Figure 7 shows another example injection device 700 according to an embodiment of the invention. A handle 710 is coupled to a plate 712 that is shaped to be places against the conjunctiva of a patient's eye. A number of

micro-needles 714 are located on a face of the plate 712. Similar to the example injection device 600 of Figure 6, the micro-needles 714 are dimensioned to break a surface of the conjunctiva, but are not long enough to penetrate into any structure beneath. In one example, the micro-needles 714 will penetrate the conjunctiva, but will not penetrate the sclera. In one example, the micro-needles 714 are less than approximately 0.30 mm long. In one example, the micro-needles 714 are less than approximately 0.50 mm long.

[0027] In one example, the injection device 700 includes a drug delivery system 720 that is coupled to the micro-needles 714. In one example a reservoir (not shown) is located within the handle 710 and an actuator 724 is located on the handle 710. In one example, the actuator 724 is coupled to a piston or plunger that forces a drug from the reservoir into the micro-needles 714. As in the injection device 600 of Figure 6, in one example, the drug that is delivered includes an anesthetic.

[0028] While a number of advantages of embodiments described herein are listed above, the list is not exhaustive. Other advantages of embodiments described above will be apparent to one of ordinary skill in the art, having read the present disclosure. Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement which is calculated to achieve the same purpose may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or variations of the present invention. It is to be understood that the above description is intended to be illustrative, and not restrictive. Combinations of the above embodiments, and other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention includes any other applications in which the above structures and fabrication methods are used. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

Claims

What is claimed is:

1. An injection device, comprising:

a forceps, including gripping ends;

a drug reservoir;

a needle connected to the drug reservoir; and

a needle actuator to advance the needle between the gripping ends of the forceps, wherein a depth of penetration of the needle is limited by the actuator.

2. The injection device of claim 1, wherein the drug reservoir and the needle are part of a hypodermic syringe.

3. The injection device of claim 2, wherein the hypodermic syringe is disposable and removable from the injection device, and the injection device is reusable.

4. The injection device of claim 1, wherein the forceps are disposable and removable from the injection device, and the injection device is reusable.

5. The injection device of claim 1, further including a speculum portion coupled to a distal end of the injection device to hold a patient eyelids open when in use.

6. The injection device of claim 5, wherein the speculum portion is disposable and removable from the injection device, and the injection device is reusable.

7. The injection device of claim 1, further including a forceps actuator on a proximal end of the injection device to operate the forceps.

8. The injection device of claim 7, wherein the needle actuator and the forceps actuator are operated by a single control.

9. The injection device of claim 8, wherein the single control is timed to actuate the forceps actuator first, and the needle actuator after the forceps are in a clamped position.

10. The injection device of claim 1, wherein the forceps are formed from a substantially transparent material.

11. The injection device of claim 1, further including a drug delivery actuator on a proximal end of the injection device to interact with the hypodermic syringe and expel a drug from a distal end of the needle.

12. The injection device of claim 1, further including a light coupled to the injection device.

13. The injection device of claim 1, further including one or more electrically powered actuators.

14. A method, comprising:

actuating a first control on an injection device to clamp a forceps on a portion of a conjunctiva and concurrently move a needle into the clamped portion of conjunctiva, wherein a depth of the needle into the conjunctiva is limited by the injection device, and

actuating a second control on the injection device to expel an amount of a drug through the needle into the conjunctiva.

15. The method of claim 14, wherein actuating the second control on the injection device to expel the amount of a drug includes expelling an amount of anesthetic.

16. The method of claim 14, further including removing a disposable syringe from the injection device and replacing the first syringe with a second syringe.

17. The method of claim 14, further including removing a forceps from the injection device and replacing the first forceps with a second forceps.

18. An injection device, comprising:

an ophthalmological instrument, including a handle;

a surface coupled to the handle, the surface containing a number of micro-needles, wherein the micro-needles are dimensioned to penetrate a surface of a conjunctiva, but are not long enough to penetrate a sclera.

a drug delivery system coupled to the handle, including:

a reservoir; and

an actuator to deliver a drug from the reservoir through to the micro-needles.

19. The injection device of claim 18, wherein the handle includes a pair of forceps.

20. The injection device of claim 19, wherein the surface is part of one paddle at the end of the forceps.

21. The injection device of claim 18, wherein the micro-needles are less than approximately 0.50 mm long.

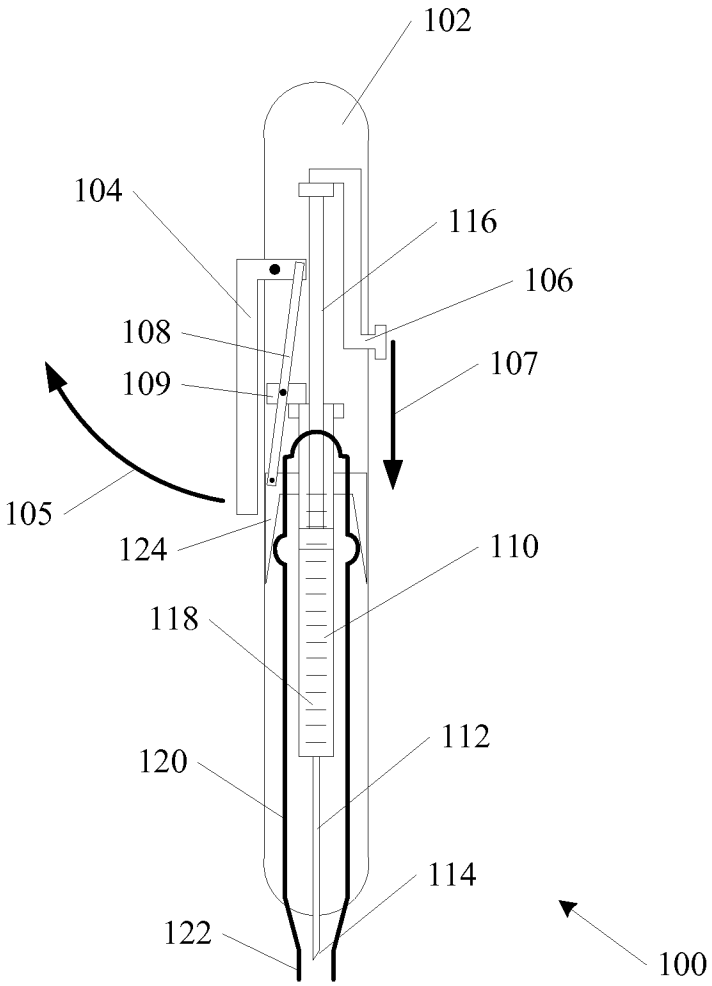

FIG. 1

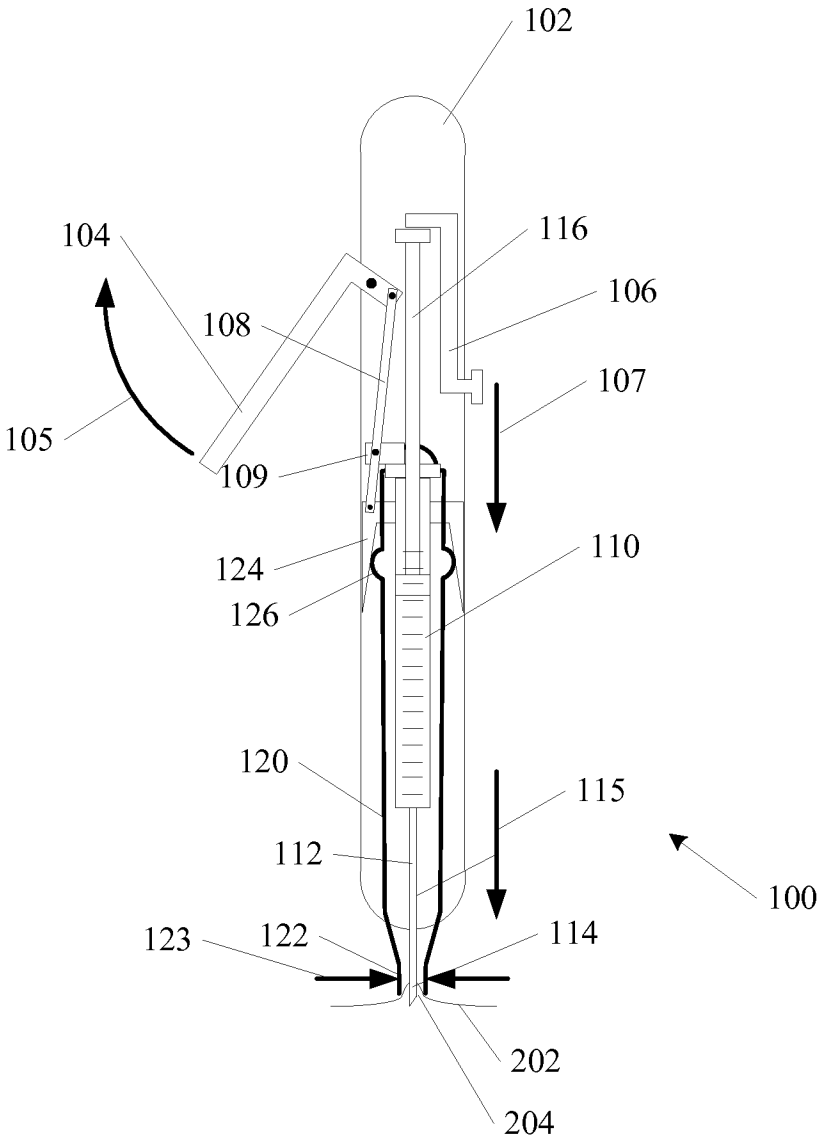
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FIG. 2

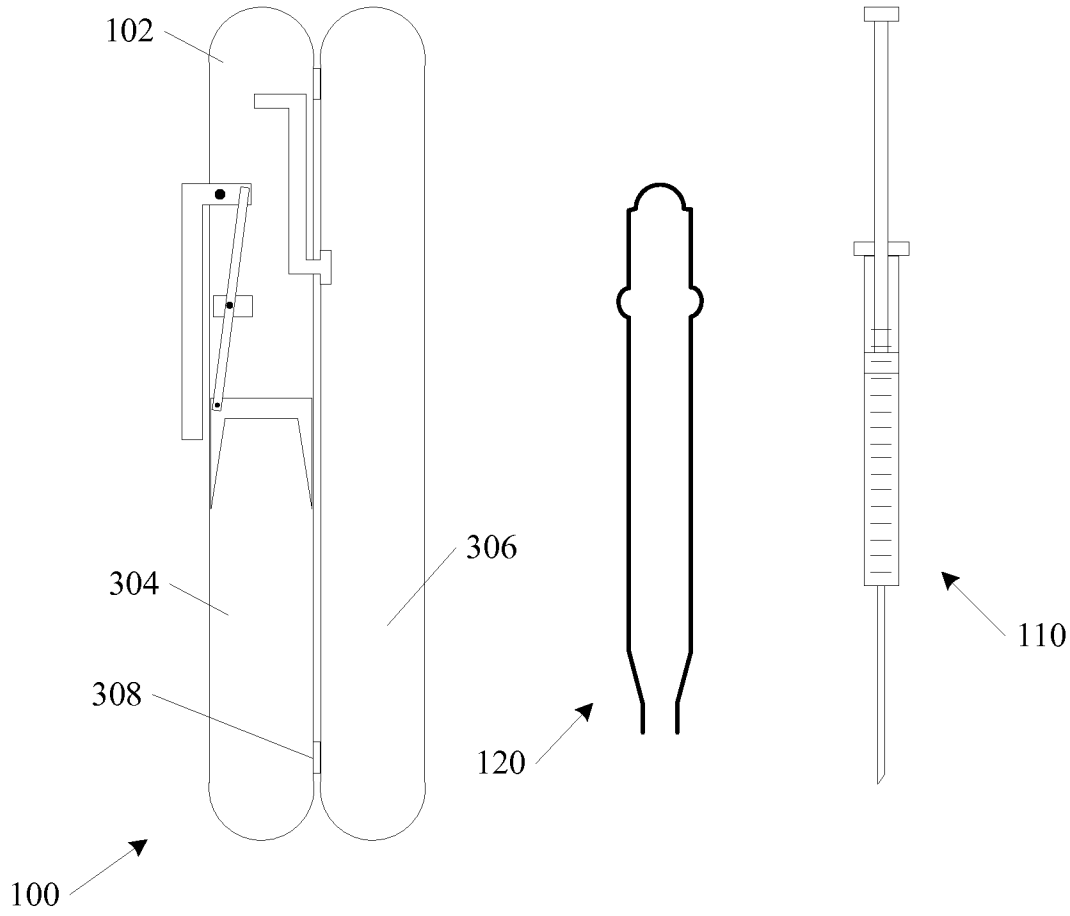

FIG. 3

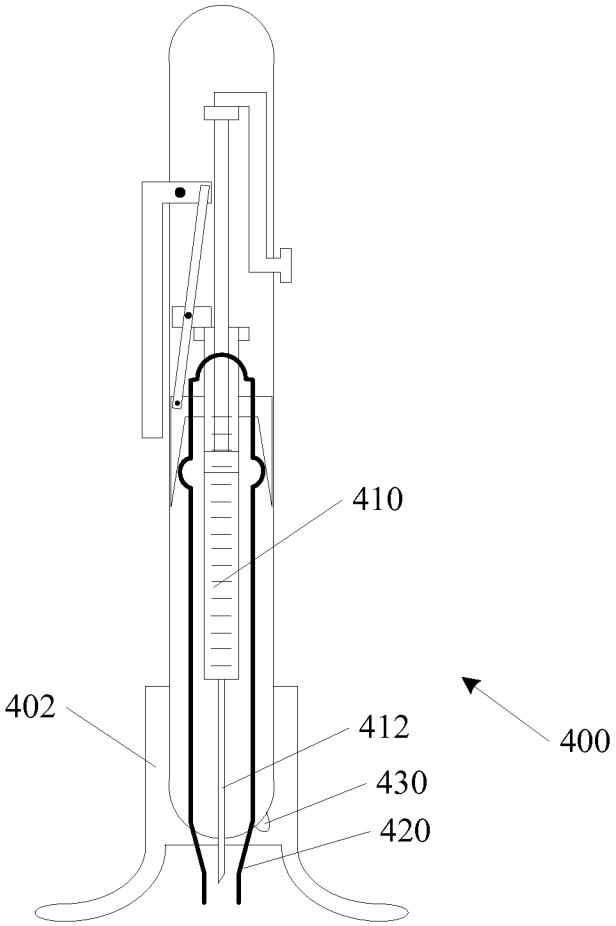

FIG. 4

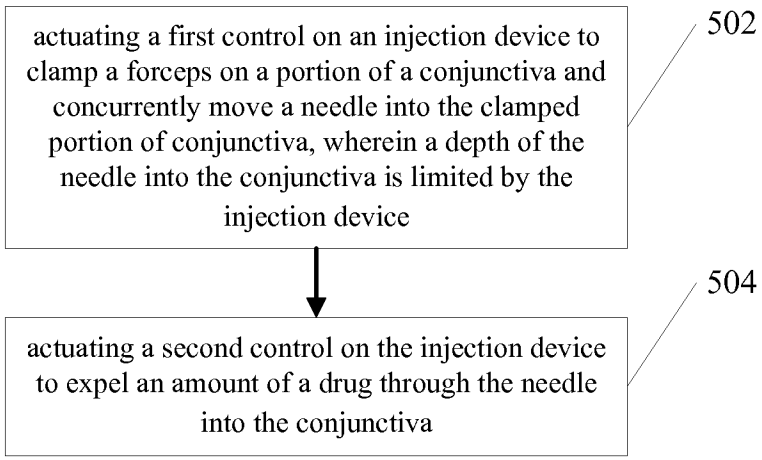
actuating a first control on an injection device to clamp a forceps on a portion of a conjunctiva and concurrently move a needle into the clamped portion of conjunctiva, wherein a depth of the needle into the conjunctiva is limited by the injection device
502
actuating a second control on the injection device to expel an amount of a drug through the needle into the conjunctiva
504

FIG. 5

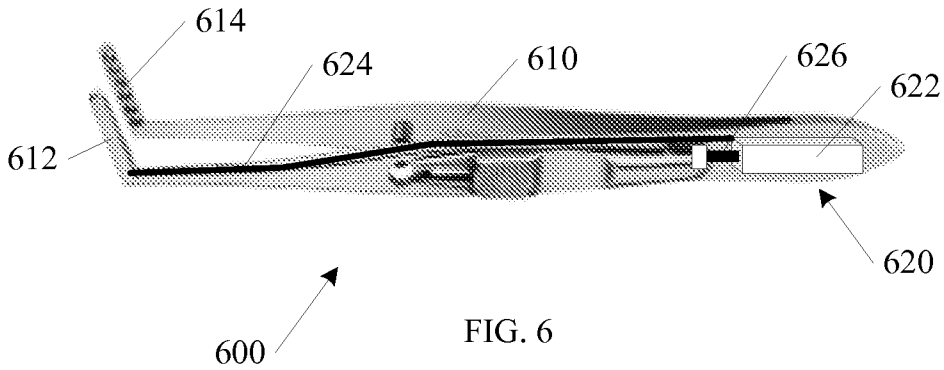

FIG. 6

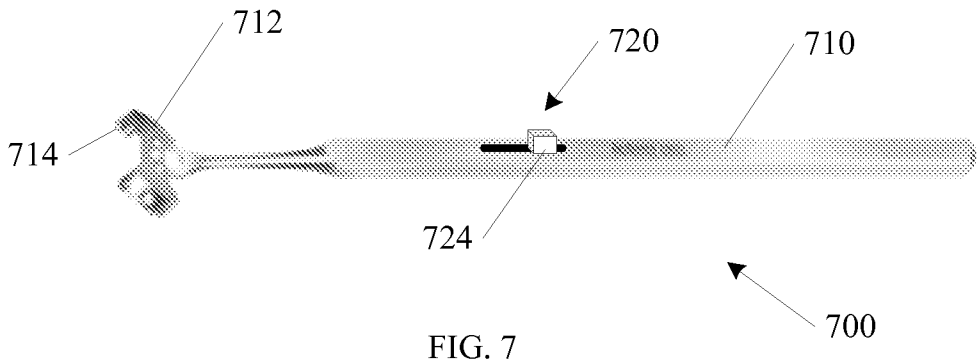

FIG. 7