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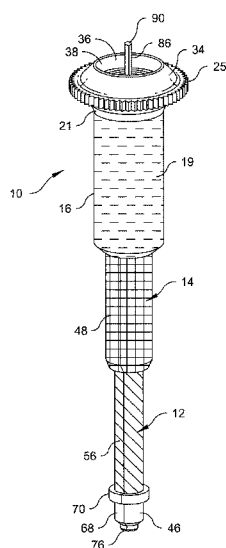
(54) **Title:** STAGED TELESCOPIC SCREW ASSEMBLY HAVING DIFFERENT VISUAL INDICATORS

Fig. 3

(57) **Abstract:** A telescopic screw assembly for an injector includes an inner screw, an outer screw and a middle screw. The middle and outer screws are in a first threaded engagement, and the inner and middle screws are in a second threaded engagement. The inner screw is nested with the middle screw and the middle screw is nested with the outer screw in a contracted configuration of the screw assembly. Rotation of the outer screw in one direction advances the middle screw relative to the outer screw via the first threaded engagement and advances the inner screw relative to the middle screw via the second threaded engagement to telescopically extend the screw assembly into an expanded configuration. At least two of the inner, middle and outer screws are identified with a different visual indicator to enhance visual distinction between the screws, and readily visually indicate an extension progress of the screw assembly.



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TITLE OF THE INVENTION

[0001] Staged Telescopic Screw Assembly Having Different Visual Indicators

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application claims priority from U.S. Provisional Patent Application No. 5 62/309,111, titled "Staged Telescopic Screw Assembly With Color Coding", filed on March 16, 2016, the entire contents of which are incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0003] The present invention relates generally to a telescopic screw assembly and more particularly to an injector having a staged telescopic screw assembly with a visual indicator 10 showing the degree of extension of the telescopic screw assembly.

[0004] Injectors or syringes are used to deliver specified quantities of drugs or medicine to a patient and typically include a chamber for storing the drug, a needle connected to the chamber through which the drug is delivered, and a plunger which pushes the medicine from the chamber through the needle. One device for pushing the drug through the chamber 15 is a manually activated plunger. The user typically holds the syringe between two fingers and activates or pushes the plunger with a thumb. One drawback of a manually activated plunger is that patients must be relatively dexterous and have the required hand strength to push the plunger themselves. Another apparatus for pushing the plunger through the chamber is a telescopic assembly. A telescopic assembly is generally contained within the 20 syringe and contains a plurality of nested members which expand to push the plunger through the chamber. One drawback of a telescopic assembly is that it can be difficult to tell whether the assembly has properly achieved its maximum extension. Thus, a user may not know whether a full dose of the drug has been administered. Another drawback of the telescopic assembly is that the assembly may extend all at once, or certain of the nested 25 members may extend in a random sequential order.

[0005] The present invention addresses the challenges associated with effectively delivering the drug from the chamber through the needle. For example, it is desirable to provide a delivery system that can move the plunger in stages according to a delivery profile based on the drug viscosity, delivery time, and rate of delivery. Furthermore, it is desirable 30 to provide a delivery system that provides a visual indicator to a patient or clinician when a full dose has been administered by an injector.

BRIEF SUMMARY OF THE INVENTION

[0006] Briefly stated, one aspect of the present invention is directed to a telescopic screw assembly for an injector comprising an inner screw, an outer screw and a middle screw. The middle screw and the outer screw are in a first threaded engagement, and the inner screw and the middle screw are in a second threaded engagement. The inner screw is nested with the middle screw and the middle screw is nested with the outer screw in a contracted configuration of the screw assembly. Rotation of the outer screw in one rotational direction advances the middle screw relative to the outer screw via the first threaded engagement and advances the inner screw relative to the middle screw via the second threaded engagement to telescopically extend the screw assembly into an expanded configuration. At least two of the inner, middle and outer screws are identified with a different visual indicator to enhance visual distinction between the inner, middle and outer screws, and readily visually indicate an extension progress of the screw assembly. A first rod member is in movable engagement with an inner channel of the inner screw during movement of the screw assembly between the contracted and expanded configurations. A distal end of the first rod member is larger than a proximal end of the inner screw, thereby preventing retraction from the inner screw. A second rod member is in movable engagement with an inner channel of the first rod member during movement of the screw assembly between the contracted and expanded configurations. A distal end of the second rod member is larger than a proximal end of the first rod member, thereby preventing retraction from the first rod member, and a proximal end of the second rod member is fixed to the injector to prevent movement of the second rod member to thereby prevent overextension of the screw assembly.

[0007] Briefly stated, another aspect of the present invention is directed to a telescopic screw assembly for an injector comprising an inner screw and an outer screw. The inner screw and the outer screw are in a threaded engagement, and the inner screw is radially nested with the outer screw in a contracted configuration of the screw assembly. Rotation of the outer screw in one rotational direction advances the inner screw relative to the outer screw via the threaded engagement to telescopically extend the screw assembly into an expanded configuration. At least one of the inner and outer screws is identified with a different visual indicator to enhance visual distinction between the inner and outer screws and readily visually indicate an extension progress of the screw assembly. A rod member is in movable engagement with an inner channel of the inner screw during movement of the

screw assembly between the contracted and expanded configurations. A distal end of the rod member is larger than a proximal end of the inner channel of the inner screw, and a proximal end of the rod member is fixed to the injector to prevent movement of the rod member to thereby prevent overextension of the screw assembly.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The following detailed description of a preferred embodiment of the invention, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, there is shown in the drawings a preferred embodiment of the telescopic screw assembly which is presently preferred. It should be understood, however, that the invention is not limited to the precise arrangements and instrumentalities shown. In the drawings:

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[0009] Fig. 1 is a sectional perspective view of a telescopic screw assembly in a contracted configuration in accordance with one embodiment of the present invention;

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[0010] Fig. 2 is a front perspective view of the telescopic screw assembly of Fig. 1 in a partially extended configuration, an outer screw of the telescopic screw assembly being shaded to indicate gray color coding and a middle screw of the telescopic screw assembly being shaded to indicate yellow color coding;

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[0011] Fig. 3 is a front view of the screw assembly of Fig. 1 in a fully extended configuration, the outer screw being shaded to indicate gray color coding, the middle screw being shaded to indicate yellow color coding, and an inner screw of the telescopic screw assembly being shaded to indicate green color coding; and

[0012] Fig. 4 is a sectional view of the screw assembly of Fig. 1 in a fully extended configuration.

DETAILED DESCRIPTION OF THE INVENTION

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[0013] Certain terminology is used in the following description for convenience only and is not limiting. The words “right,” “left,” “lower,” and “upper” designate directions in the drawings to which reference is made. The words “inwardly” or “distally” and “outwardly” or “proximally” refer to directions toward and away from, respectively, the geometric center or orientation of the telescopic screw assembly and related parts thereof.

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Unless specifically set forth herein, the terms “a,” “an” and “the” are not limited to one element but instead should be read as meaning “at least one”. The terminology includes the above-listed words, derivatives thereof and words of similar import.

[0014] It should also be understood that the terms “about,” “approximately,” “substantially” and like terms, used herein when referring to a dimension or characteristic of a component of the invention, indicate that the described dimension/characteristic is not a strict boundary or parameter and does not exclude minor variations therefrom that are functionally similar. At a minimum, such references that include a numerical parameter would include variations that, using mathematical and industrial principles accepted in the art (e.g., rounding, measurement or other systematic errors, manufacturing tolerances, etc.), would not vary the least significant digit.

[0015] Referring to Figs. 1-4, the present application is directed to a telescopic screw assembly in accordance with one embodiment of the present invention, generally designated with reference numeral 10. Fig. 1 is a sectional view of the screw assembly 10 in a contracted configuration which includes an outer screw 16, a middle screw 14, and an inner screw 12 nested inside of one another to allow the screw assembly to telescopically expand to an extended configuration (Fig. 3). The screw assembly 10 can be inserted into an injector or syringe (not shown) to allow the screw assembly 10 to push medicine out of a needle (not shown) connected to the syringe. One example of an injector contemplated for use with the current invention is disclosed in U.S. Patent No. 8,157,769, the disclosure of which is hereby incorporated by reference as if fully set forth herein. Each of the outer screw 16, middle screw 14, and inner screw 12 is color coded to allow a user or clinician to observe whether full extension was achieved by the screw assembly 10 to administer a full dose of medicine as explained in greater detail below. Furthermore, the first threaded engagement between the outer screw 16 and middle screw 14, and the second threaded engagement between the middle screw 14 and inner screw 12 have different thread pitches to ensure that the screw assembly 10 extends in a desired sequential order as also explained in greater detail below.

[0016] The outer screw 16 includes a body 19 having a generally cylindrical outer shape to fit within an injector having a cylindrical internal cavity (not shown). The outer screw 16 is rotatable with respect to the injector (not shown). A neck 21 extends upwardly from the body 19 and serves as a transition between the body 19, which has a smaller diameter than the neck 21, and a head 23, which has a larger diameter than the neck 21. The neck 21 has a shape to minimize any stress concentrations that may be present in the outer screw 16. An upper wall 29 extends upwardly from the neck 21 and abuts the head 23. The upper wall 29

has a generally cylindrical shape with a diameter sized to maintain the position of the screw assembly 10 within the injector (not shown).

[0017] The head 23 includes a gear 25 which is oriented to rotate about an axis 30 extending between a proximal end 18 and a distal end 20 of the screw assembly 10. The gear 25 is adapted to engage an element of the syringe (not shown, but could be a thumb wheel, a gear attached to a motor or similar driving mechanism, etc.) to rotate the gear 25, and thus, the outer screw 16. As should be understood by one of ordinary skill in the art, any suitable type of gear could be adopted (*e.g.* spur gear, helical gear, bevel gear). The proximal end 18 of the head 23 has a proximal portion 32 which extends upwardly and radially inwardly from the gear 25. The outer surface 34 of the proximal portion 32 has a frustoconical shape, while the inner surface 36 of the proximal portion 32 is an annular wall 38 extending upwardly from a shoulder 40 and defines a recess within the proximal portion 32 above the shoulder 40.

[0018] Although the outer screw 16 is shown with the body 19, neck 21, and head 23 all formed as a monolithic element, the body 19, neck 21, or head 23 could each be formed as a separate element and connected to the other elements of the outer screw 16 by traditional fastening methods (*e.g.* welding, adhesive, screws, or the like). Furthermore, the outer screw 16 (as well as any other elements of the screw assembly 10) can be manufactured from plastic, polymers, stainless steel, etc. by traditional methods (*e.g.* molding, additive manufacturing, machining, or the like). An opening 17 extends through the outer screw 16 from the proximal end 18 to the distal end 20. As should be understood by one of ordinary skill in the art, the opening 17 need not extend completely through the proximal end 18 of the outer screw 16. However, an opening 17 which does extend through the proximal end 18 facilitates easier loading of the middle screw 14 into the opening 17. The opening 17 is sized to receive an inner screw 12 and a middle screw 14. Alternatively, the screw assembly 10 can omit a middle screw 14 or include more than one middle screw 14. An outer screw inner thread 22 is formed along at least a portion of the opening 17, and preferably, along a majority of the opening 17. The outer screw inner thread 22 can have any desired thread pitch provided that it mates with a middle screw outer thread 24. A protrusion 42 is formed at the distal end 20 of the inner thread 22 and extends generally perpendicularly away and radially inwardly from the outer screw 16 and into the opening 17 to prevent movement of the middle screw 14 distally beyond the protrusion 42.

[0019] The middle screw 14 has a generally cylindrical, tubular shape designed to fit within the opening 17 with a length equal to or at least slightly less than that of the outer screw 16 such that the middle screw 14 fits completely within the opening 17 when the screw assembly 10 is in the contracted configuration best seen in Fig. 1. The middle screw 14 includes an unthreaded portion 48 which has an outer diameter less than the diameter of the outer screw inner thread 22 and less than the inner diameter of the protrusion 42 to allow the unthreaded portion 48 to move within the opening 17 and beyond the protrusion 42. A middle screw outer thread 24 is formed on the proximal end 18 of the middle screw 14 which includes threads having a pitch which meshes with the outer screw inner thread 22 such that rotation of the outer screw 16 relative to the middle screw 14 advances the middle screw 14 (distally or downwardly when viewing Figs. 1-4) along the axis 30. Of course, the middle screw outer thread 24 could be formed anywhere along the middle screw 12 if desired. However, the distance the outer thread 24 extends toward the distal end 20 of the middle screw 14 limits the travel distance of the middle screw 14 because of the interference between the protrusion 42 and the outer thread 24 as the middle screw 14 moves distally within the opening 17.

[0020] A cylindrical passageway 50 extends through the middle screw 14 from the proximal end 18 to the distal end 20 with a middle screw inner thread 26 formed thereon. The pitch of the middle screw outer thread 24 is preferably different from, but can be the same as, the pitch of the middle screw inner thread 26. More preferably, the pitch of the outer thread 24 is smaller than the pitch of the inner thread 26. The passageway 50 includes a radially inwardly extending projection 52 at the distal end of the passageway 50 as shown in Figs. 1 and 4 to prevent movement of the inner screw 12 when the inner screw outer thread 28 contacts the projection 52. Alternatively, the projection 52 can be positioned anywhere along the passageway 50. The distal end of the middle screw 14 has a chamfer 54 which facilitates insertion of the middle screw 14 into the opening 17 of the outer screw 16 from the proximal end 18. The middle screw 14 has an outer diameter sized to prevent a cap 46 on the distal end of the inner screw 12 from entering the passageway 50.

[0021] The inner screw 12 has a generally cylindrical, tubular shape and is positionable within the passageway 50. The inner screw 12 includes an unthreaded portion 56 which has a smaller diameter than the inner screw outer thread 28 and is sized to rotate within the passageway 50 to move along the axis 30 and through the opening defined by the projection 52. An inner screw outer thread 28 is formed adjacent the proximal end of the inner screw

12 and engages the middle screw inner thread 26. The threaded engagement between the inner screw outer thread 28 and middle screw inner thread 26 causes movement of the inner screw 12 along the axis 30 as the middle screw 14 is rotated relative to the inner screw 12.

[0022] As should be understood by one of ordinary skill in the art, the difference in thread pitches of the middle screw outer thread 24 and the middle screw inner thread 26 ensures that as a rotational force is applied to the gear 25, the middle screw 14 advances distally along the axis 30 before the inner screw 12 moves, as best seen in Fig. 2. As the rotational force continues to be applied to the gear 25, the inner screw 12 only begins to move once the middle screw outer thread 22 contacts the protrusion 42 and the middle screw 14 can no longer advance. After this contact, the middle screw 14 begins to rotate as the rotational force continues to be applied to the gear 25 and causes the inner screw 12 to extend distally, as best seen in Figs. 3-4. Of course, the pitch of the middle screw outer thread 24 can be relatively large, provided that the pitch of the middle screw inner thread 26 is larger. As should be understood by one of ordinary skill in the art, the size of the pitch on either thread 24, 26 can influence the delivery profile and can be based on drug viscosity, delivery time, rate of delivery of the drug, and other factors. Alternatively, the pitch of the threads 24, 26 could be changed to ensure that the inner screw 12 moves first, that the inner screw 12 and middle screw 14 extend simultaneously, that both extend simultaneously but one extends faster than the other, etc. One advantage of controlling the stages of delivery is it ensures that the screw assembly 10 provides its strongest extension force for the greatest amount of time.

[0023] A generally cylindrical channel 60 extends through the inner screw 12 and is sized to receive a first member 64. The channel 60 has a generally smooth surface to allow the first member 64 to slide along the length of the channel 60. The proximal portion 66 of the channel 60 defines a narrower opening than the rest of the channel 60 to prevent the first member 64 from exiting the channel 60. A pocket 62 is formed in the distal portion 58 of the channel 60 to secure the cap 46 to the inner screw 12. The pocket 62 can be a continuous pocket which extends completely around the internal surface of the channel 60, or can be one or more individual pockets which extend only partially around the channel 60 to receive individually formed protrusions on the cap 46. Alternatively, the inner screw 12 could be formed without the pocket 62 and a press-fit, screw, weld, etc. could be used to couple the cap 46 to the inner screw 12. In yet another alternative, the cap 46 and inner

screw 12 could be formed as a monolithic element, thus avoiding the need for any coupling element between the two.

[0024] The cap 46 has a cylindrical base 68 with a collar 70 extending radially away from the base 68. The collar 70 is generally cylindrical and has a larger outer diameter than the diameter of the middle screw passageway 50 to prevent the collar 70 from entering the passageway 50 by contacting the distal end of the middle screw 14. Of course, the base 68 could have a wide enough diameter that the collar 70 can be omitted. A stem 72 extends upwardly from the base 68 and is sized to extend into the channel 60. The length of the stem 72, as measured along the axis 30, is such that a flange 74 aligns with the pocket 62. The flange 74 extends outwardly from the stem 72 and is configured to be positioned in the pocket 62 to secure the cap 46 to the inner screw 12. A threaded tail 76 extends downwardly from the base 68 and is configured to engage a plunger (not shown) which can push medicine through a chamber of an injector (not shown) as the telescopic screw assembly 10 moves from the contracted configuration (Fig. 1) through the partially extended configuration (Fig. 2) to the fully extended configuration (Figs. 3-4).

[0025] The first member 64 has a generally cylindrical, tubular structure with a length preferably shorter than the inner screw 12 such that the first member 64 remains within the channel 60 when the screw assembly 10 is in the contracted configuration shown in Fig. 1. The first member 64 has an outer diameter sized to allow movement within the channel 60, and can include an outwardly extending flare (not shown) on the distal end 80 which contacts a reduced diameter segment (not shown) on the proximal end of the inner screw 12 to prevent the first member 64 from exiting the channel 60 as the screw assembly 10 moves between the contracted configuration shown in Fig. 1 to the extended configuration shown in Figs. 3-4. The first member 64 includes a generally cylindrical passageway 84 sized to receive a second member 86. The passageway 84 includes the narrow proximal portion 66 which slides along the second member 86 but is prevented from going past a flared portion 88 of the second member 86 as best seen in Fig. 4.

[0026] The second member 86 is a generally cylindrical rod positioned within the passageway 84. The proximal end 90 of the second member 86 can be fixed by a snap fit, set screw, etc. to the injector (not shown) to prevent movement of the second member 86. One advantage of fixing the second member 86 to the injector (not shown) is to prevent overextension of the screw assembly 10 via the various interference fits between the elements of the assembly 10.

[0027] The outer screw 16, middle screw 14, and inner screw 12 can each include a visual indicator to allow a clinician to observe the progress of the administering of the drug and whether the screw assembly 10 achieved full extension when administering a dose via the injector (not shown). In one embodiment, for example, without limitation, the outer screw 16 is gray, the middle screw 14 is yellow, and the inner screw 12 is green, and all are readily observable through a transparent, translucent, or open window of an injector (not shown). As should be understood by one of ordinary skill in the art, the colors selected for the screws 12, 14, 16 can be any desired color scheme suitable to permit visual distinction between the outer, middle, and inner screws 16, 14, 12. Alternatively, stripes, dots, hatching, etc. could be used to distinguish the screws 12, 14, 16 from one another instead of a solid color. One advantage of such an indicator is that a patient can observe whether the injection is complete or if continued application of the injector to the injection site is required. Furthermore, such an indicator allows a clinician or failure investigation team to determine if a drug was used as prescribed or intended.

[0028] In use, a user places a cartridge containing the drug in the injector (not shown) and may input information regarding the drug into the injector to allow the injector to determine maximum flow rate, viscosity, etc. from which the injector can calculate the optimal expansion rate and torque to apply to the screw assembly 10. The user then activates the screw assembly 10 by pressing a button, activating a thumb wheel, voice command etc. (not shown). The outer screw 16 begins to turn when a rotational force is applied to the gear 25. As the outer screw 16 rotates, the middle screw 14 is moved from the contracted configuration (Fig. 1) to the partially expanded configuration (Fig. 2). Once the middle screw outer thread 24 contacts the protrusion 42 the middle screw 14 can no longer move distally. The middle screw 14 then begins to rotate as the rotational force continues to be applied to the gear 25. As the middle screw 14 rotates, the inner screw 12 moves from the contracted configuration within the middle screw 14 (Fig. 2) to the fully expanded configuration (Figs. 3-4). A plunger (not shown) connected to the cap 46 pushes through the cartridge (not shown) to transfer the drug out of the cartridge as the middle screw 14 and inner screw 12 move distally. The user receives visual indication regarding the degree of expansion of the screw assembly 10 from the visual indicators (e.g. colors) of the inner, middle, and outer screws 12, 14, 16. Once the drug delivery is complete, an opposite rotational force can be applied to the gear 25 to return the screw assembly 10 to the contracted configuration.

[0029] It will be appreciated by those skilled in the art that changes could be made to the embodiments described above without departing from the broad inventive concept thereof. It is understood, therefore, that this invention is not limited to the particular embodiment(s) disclosed, but it is intended to cover modifications within the spirit and
5 scope of the present invention, as set forth in the appended claims.

CLAIMS

We claim:

1. A telescopic screw assembly for an injector comprising:
an inner screw, an outer screw and a middle screw,
5 the middle screw and the outer screw being in a first threaded engagement,
and the inner screw and the middle screw being in a second threaded
engagement, the inner screw being nested with the middle screw and the middle
screw being nested with the outer screw in a contracted configuration of the
screw assembly,
10 wherein rotation of the outer screw in one rotational direction advances the
middle screw relative to the outer screw via the first threaded engagement and
advances the inner screw relative to the middle screw via the second threaded
engagement to telescopically extend the screw assembly into an expanded
configuration, and
15 at least two of the inner, middle and outer screws being identified with a
different visual indicator to enhance visual distinction between the inner, middle
and outer screws and readily visually indicate an extension progress of the screw
assembly;
a first rod member in movable engagement with an inner channel of the inner screw
20 during movement of the screw assembly between the contracted and expanded
configurations, a distal end of the first rod member being larger than a proximal end of the
inner screw, thereby preventing retraction from the inner screw; and
a second rod member in movable engagement with an inner channel of the first rod
member during movement of the screw assembly between the contracted and expanded
25 configurations, a distal end of the second rod member being larger than a proximal end of
the first rod member, thereby preventing retraction from the first rod member, and a
proximal end of the second rod member being fixed to the injector to prevent movement of
the second rod member to thereby prevent overextension of the screw assembly.
- 30 2. The telescopic screw assembly of claim 1, wherein the different visual
indicator of the at least two of the inner, middle and outer screws is a different color coding
of the at least two of the inner, middle and outer screws.

3. The telescopic screw assembly of claim 1, wherein the outer screw comprises a body and a gear proximate a proximal end of the body, the gear being configured to engage a driving member to rotate the outer screw about a central axis thereof.

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4. The telescopic screw assembly of claim 1, wherein the outer screw includes an inner channel extending therethrough, the inner channel of the outer screw being sized to receive the middle screw and the inner screw.

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5. The telescopic screw assembly of claim 4, wherein the inner channel of the outer screw includes an inner thread along at least a portion thereof, and a radially inwardly extending protrusion proximate a distal end of the inner thread, the protrusion being sized to prevent distal advancement of a proximal end of the middle screw beyond the protrusion.

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6. The telescopic screw assembly of claim 1, wherein the middle screw defines a length substantially equal to a length of the outer screw.

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7. The telescopic screw assembly of claim 5, wherein the middle screw includes an unthreaded outer portion having an outer diameter less than a diameter of the inner thread of the outer screw and less than an inner diameter of the protrusion, whereby the unthreaded outer portion of the middle screw is distally advanceable through the inner channel of the outer screw and beyond the protrusion thereof.

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8. The telescopic screw assembly of claim 7, wherein the middle screw further includes an outer thread proximate a proximal end thereof, the outer thread of the middle screw defining a complementary pitch with a pitch of the inner thread of the outer screw and meshing therewith to define the first threaded engagement.

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9. The telescopic screw assembly of claim 8, wherein the middle screw further comprises an inner passageway extending therethrough, the inner passageway of the middle screw being sized to receive the inner screw.

10. The telescopic screw assembly of claim 9, wherein the middle screw further comprises an inner thread along at least a portion of the inner passageway thereof, the inner thread of the middle screw defining a different pitch from the pitch of the outer thread of the middle screw.

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11. The telescopic screw assembly of claim 10, wherein the pitch of the outer thread of the middle screw is smaller than the pitch of the inner thread of the middle screw.

12. The telescopic screw assembly of claim 9, wherein the inner passageway of
10 the middle screw includes a radially inwardly extending projection at a distal end thereof, the projection being sized to prevent distal advancement of a proximal end of the inner screw beyond the projection.

13. The telescopic screw assembly of claim 10, wherein the inner screw
15 comprises an outer thread proximate a proximal end thereof, the outer thread of the inner screw defining a complementary pitch with the pitch of the inner thread of the middle screw and meshing therewith to define the second threaded engagement.

14. The telescopic screw assembly of claim 13, wherein the inner screw further
20 comprises an unthreaded outer portion having an outer diameter less than a diameter of the inner thread of the middle screw and less than an inner diameter of the radially inwardly extending projection, whereby the unthreaded outer portion of the inner screw is distally advanceable through the inner passageway of the middle screw and beyond the projection thereof.

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15. The telescopic screw assembly of claim 9, further comprising a cap secured
to a distal end of the inner screw, the cap being engageable with a plunger of a chamber within the injector containing a substance to be dispensed, and wherein the inner
passageway of the middle screw is sized to prevent the cap from entering the inner
30 passageway.

16. The telescopic screw assembly of claim 1, wherein the inner channel of the inner screw defines a generally smooth inner surface and the proximal end of the inner screw defines a narrower opening than a diameter of the inner channel of the inner screw.

5 17. The telescopic screw assembly of claim 16, wherein the distal end of the first rod member is radially outwardly flared relative to a remainder of the first rod member.

18. The telescopic screw assembly of claim 1, wherein the first rod member defines a length equal to, or less than, a length of the inner screw.

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19. The telescopic screw assembly of claim 1, wherein the inner channel of the first rod member defines a generally smooth inner surface and the proximal end of the first rod member defines a narrower opening than a diameter the inner channel of the first rod member.

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20. The telescopic screw assembly of claim 19, wherein the distal end of the second rod member is radially outwardly flared relative to a remainder of the second rod member.

20 21. A telescopic screw assembly for an injector comprising:
an inner screw and an outer screw,

the inner screw and the outer screw being in a threaded engagement, and the inner screw being radially nested with the outer screw in a contracted configuration of the screw assembly, wherein rotation of the outer screw in one rotational direction advances the inner screw relative to the outer screw via the threaded engagement to telescopically extend the screw assembly into an expanded configuration, and

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at least one of the inner and outer screws being identified with a different visual indicator to enhance visual distinction between the inner and outer screws and readily visually indicate an extension progress of the screw assembly; and

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a rod member in movable engagement with an inner channel of the inner screw during movement of the screw assembly between the contracted and expanded configurations, a distal end of the rod member being larger than a proximal end of the inner

channel of the inner screw, and a proximal end of the rod member being fixed to the injector to prevent movement of the rod member to thereby prevent overextension of the screw assembly.

5 22. The telescopic screw assembly of claim 21, wherein the different visual indicator of the at least one of the inner and outer screws is a different color coding of the at least one of the inner and outer screws.

10 23. The telescopic screw assembly of claim 21, wherein the outer screw comprises a body and a gear proximate a proximal end of the body, the gear being configured to engage a driving member to rotate the outer screw about a central axis thereof.

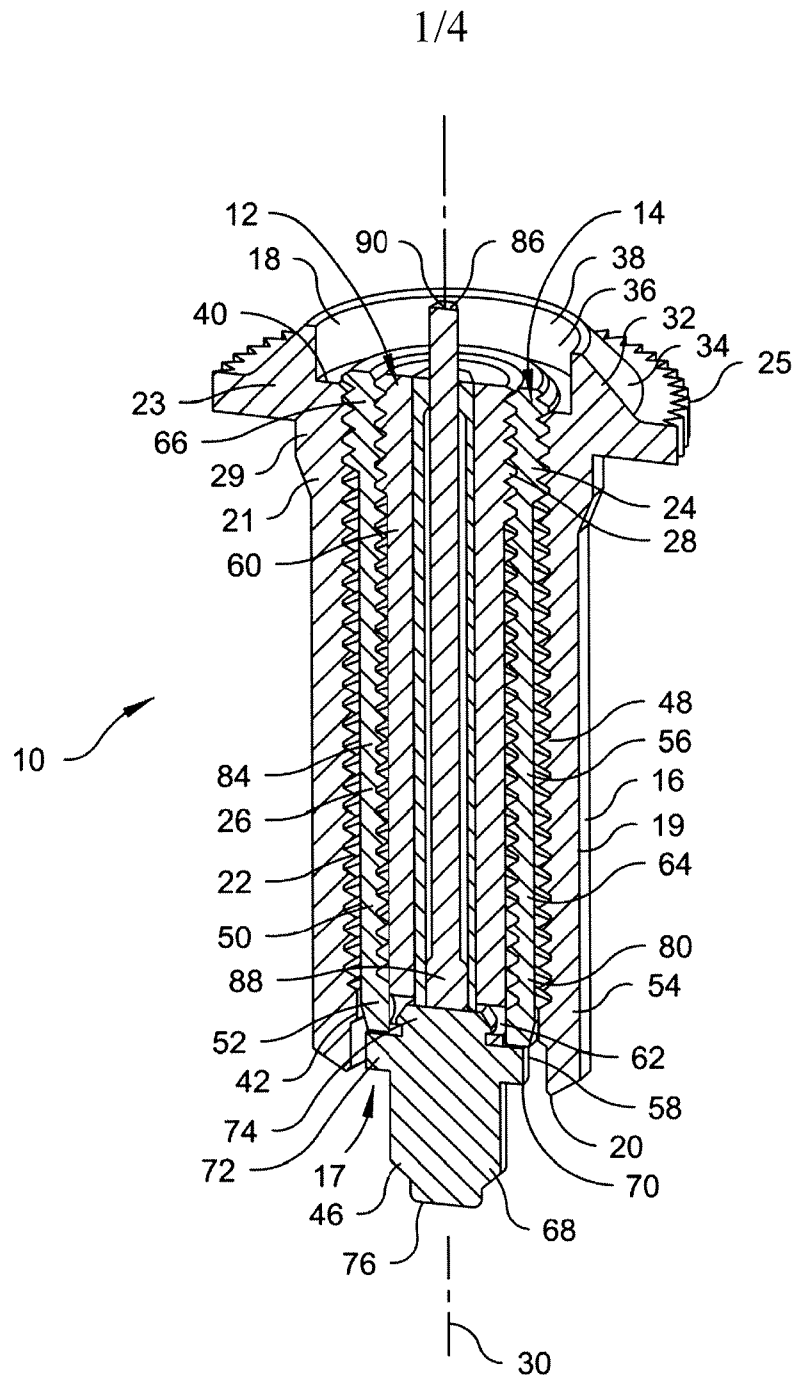


Fig. 1

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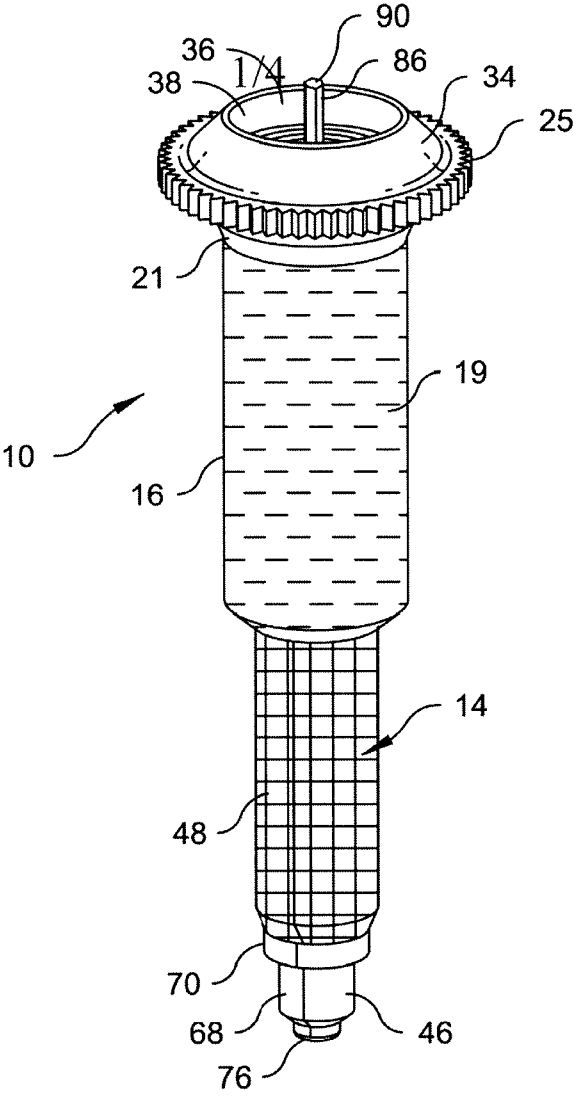


Fig. 2

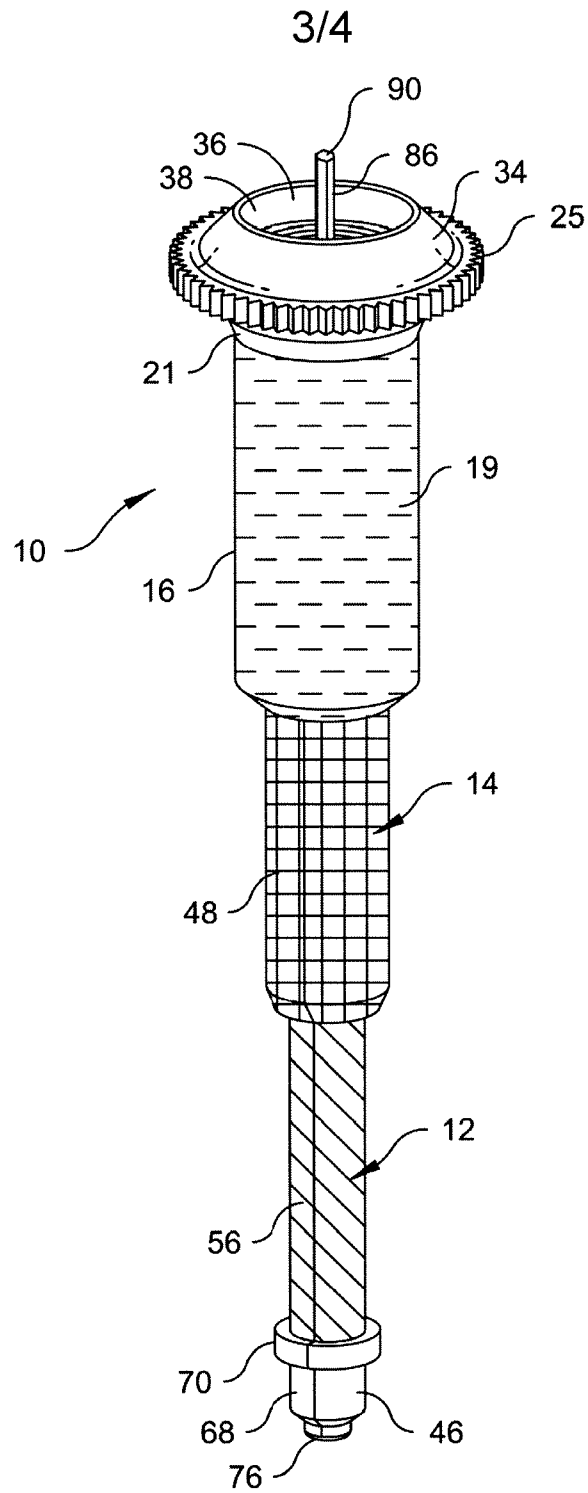
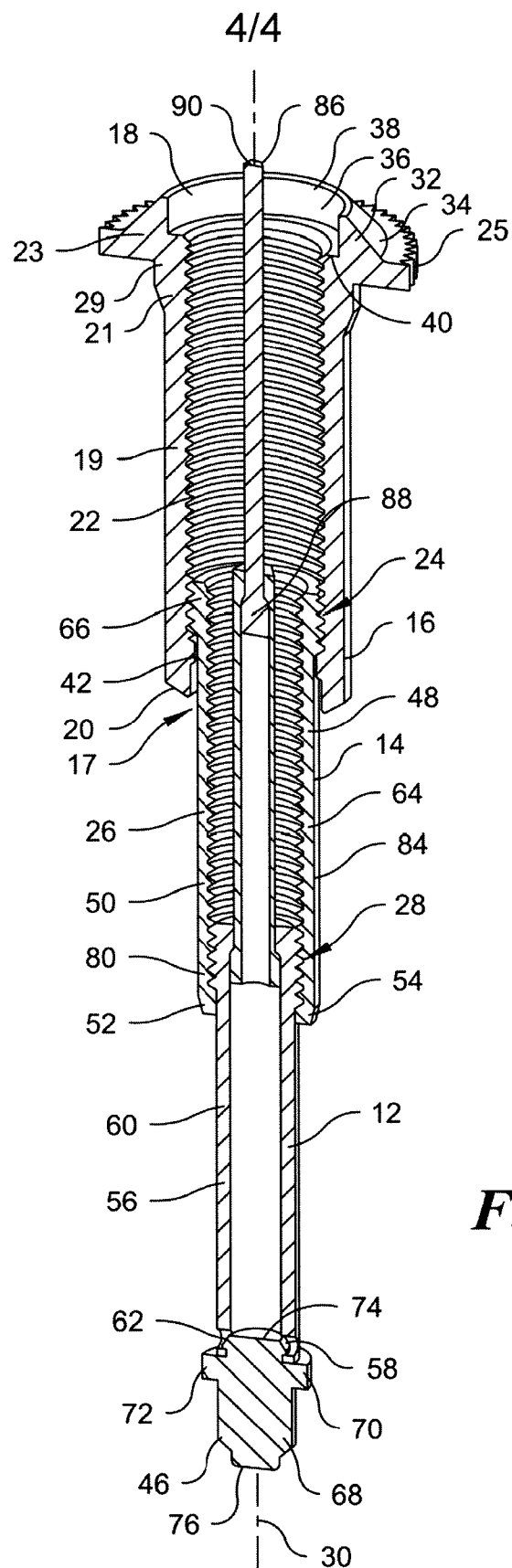


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/022639

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M5/315 F16H25/20
ADD.

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)
A61M F16H

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraph [0006] - paragraph [0032]; figures 1-9	1-23
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A	----- US 5 282 593 A (FAST DUANE [US]) 1 February 1994 (1994-02-01) figure 3	1-23
Y	----- US 2013/331791 A1 (GROSS YOSSI [IL] ET AL) 12 December 2013 (2013-12-12) paragraph [0061] - paragraph [0080]; claims 6, 8, 22, 25; figures 2A-2C ----- -/-	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

26 June 2017

Date of mailing of the international search report

06/07/2017

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/022639

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