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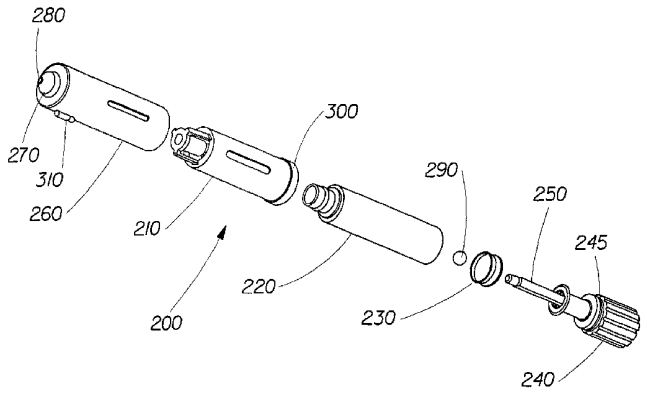
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(54) Title: DISPOSABLE CARTRIDGE FOR ELECTROSTATIC SPRAY DEVICE



(57) Abstract: An electrostatic spraying device being configured and disposed to electrostatically charge and dispense a product from a supply to a point of dispersal. This device has a reservoir configured to contain the supply of product and a nozzle to disperse the product. A channel is disposed between the reservoir and the nozzle, wherein the channel permits the electrostatic charging of the product upon the product moving within the channel. A positive displacement mechanism is used to move the product from the reservoir to the nozzle. A portion of the high voltage electrode being disposed between the reservoir and the nozzle is used to electrostatically charge the product within the channel at a charging location. A mixing mechanism may be disposed between the reservoir and the nozzle to reconstitute any product which may have separated. The high voltage contact may be spring biased in direction towards the high voltage electrode. The high voltage electrode may be annular to improve contact with the high voltage contact. A locking mechanism may be added to secure the connection between the high voltage contact and the high voltage electrode. A locking feature may be added to secure the disposable cartridge within the device. An ejection feature may be added to release the disposable cartridge from the device.

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DISPOSABLE CARTRIDGE FOR ELECTROSTATIC SPRAY DEVICE

Cross-Reference To Related Application

This application is a continuation-in-part of our earlier applications, U.S. Serial No. 09/377,332, filed on Aug 18, 1999 and U.S. Serial No. 09/377,333, filed on Aug 18, 1999.

Technical Field of Invention

This invention relates to a disposable cartridge for a portable electrostatic spray device designed for personal use. More particular, this invention is focused on improvements for product mixing and maintaining a superior high voltage connection.

Background of the Invention

In US4380786, Kelly offers a refillable reservoir system. However, the system described by Kelly does not integrally include a nozzle with the delivery system. The system, as described, would cross contaminate the liquid delivery system when it would be desired to use multiple liquids as Kelly's delivery system is simply a piston operated pump with a dip tube extending into the product reservoir. To avoid cross-contamination this system would necessitate an added cleaning step with a specialized cleaning solution. Furthermore, Kelly does not include a positive displacement system. Rather, Kelly has a non-continuous delivery system in that fluid is delivered in response to user actuation of lever arm 266. As such, Kelly's flow rate will be variable because the rate at which the lever is depressed may vary due to inconsistent actuation force from the user. Kelly's system also does not recognize the need and therefore does not offer a solution to limiting electrical current passing through the product reservoir. Lastly, Kelly does not offer a means by which to mix the product in the reservoir.

In US6079634, Noakes offers a disposable reservoir system. The Noakes system is not a "clean" design, as the electrode stays connected with the device and would be a common element for all reservoirs in communication with the device. Noakes' electrode is a source for cross-

contamination between products from different reservoirs. Further, . Noakes' electrode design is a thin metal wire, which has an increased breakage potential. Further, the system described by Noakes is a non-continuous delivery system. Further, Noakes does not recognize or offer a solution for the problem of limiting electrical current passing through the product reservoir. Further, Noakes does not offer a method to incorporate a mixing feature in the reservoir to mix product. Finally, Noakes does not address the problem of removing or re-using a partially filled reservoir. With the reservoir being punctured by the electrode, removal of a partially filled reservoir may be messy. Further, when the partially filled reservoir is desired for use again, one would need to align the electrode with the previous puncture site, or create a different puncture and then devise a way to prevent product leakage from the previous puncture site.

Summary of the Invention

A disposable cartridge for an electrostatic spraying device which is configured and disposed to electrostatically charge and dispense a product from a supply to a point of dispersal. The electrostatic spraying device has a reservoir configured to contain the supply of product and a nozzle to disperse the product. The nozzle being disposed at the point of dispersal. The nozzle has an exit orifice. A channel is disposed between the reservoir and the nozzle, wherein the channel permits the electrostatic charging of the product upon the product moving within the channel. A positive displacement mechanism is used to move the product from the reservoir to the nozzle. A power source supplies an electrical charge. A high voltage power supply, high voltage contact, and high voltage electrode are used. A portion of the high voltage electrode being disposed between the reservoir and the nozzle is used to electrostatically charge the product within the channel at a charging location. A mixing mechanism may be disposed between the reservoir and the nozzle to reconstitute any product which may have separated. The mixing mechanism may be a mixing ball, static mixer, disc having at least one hole, baffle having at least one opening, prop mixer.

The high voltage contact may be spring biased in direction towards the high voltage electrode. The high voltage electrode may be annular to improve contact with the high voltage contact. A locking mechanism may be added to secure the connection between the high voltage contact and the high voltage electrode. A locking feature may be added to secure the disposable cartridge within the device. An ejection feature may be added to release the disposable cartridge from the device.

Brief Description of the Drawings

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention it is believed that the same will be better understood from the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded isometric view of a disposable cartridge for a hand-held, self-contained electrostatic spraying device;

FIG. 2 is a cross-sectional view of the disposable cartridge within Fig 1;

FIG. 3 is a cross-sectional view of a disposable cartridge having a static mixer;

FIG. 4 is an isometric view of a disposable cartridge having at least one disc for increasing turbulent mixing;

FIG. 5 is an isometric view of a disposable cartridge having at least one baffle for increasing turbulent mixing;

FIG. is a cross-sectional view of a disposable cartridge having a prop mixer;

FIG. 7 is an exploded isometric view of a hand-held, self-contained electrostatic spraying device having a disposable cartridge;

FIG. 8 is an assembled isometric view of the device within Fig 7;

FIG. 9 is a cross-sectional view of the exiting portion of the device within Fig1;

FIG. 10 is an exploded isometric view of the insert sleeve and accompanying parts within Fig. 1; and

FIG. 11 is an isometric view of a disposable cartridge having a prop mixer which is unattached.

Detailed Description of the Preferred Embodiments

Referring to Figures 1 and 2, a hand-held, self-contained electrostatic spraying device 5 having a disposable cartridge 200 is shown. Disposable cartridge 200 may contain a variety of product, including but not limited to, cosmetics, skin creams, and skin lotions. The product in disposable cartridge 200 may be positively displaced (discussed infra) and powered by gearbox/motor component 10. Gearbox/motor component 10 may be fixed onto a left or first housing 30. The gearbox/motor component 10 can be affixed into place mechanically, adhesively, or by any other suitable technique. Gearbox/motor component 10 preferably comprises a precision motor 10a connected to a gearbox 10b. Power source 20 provides power to the device. An example of a suitable power source 20 includes, but is not limited to, two "AAA" type

batteries. The power source 20 provides power to the device through the control circuit 60, the high voltage power supply 40, and then the high voltage contact 50, which contacts the disposable cartridge 200. High voltage power supply 40 is powered and controlled by control circuit 60 (discussed infra). Power-on switch 80 permits the user to cause an interruption between power source 20 and circuit control 60. Power-on switch 80 is designed such that voltage is supplied to the remainder of the circuit only when switch 80 is in the "ON" or closed position. Apply switch 70 permits the user to selectively activate motor 10a, thereby activating the delivery and spraying of the product. Gearbox/motor component 10 has a driver 90 fastened to a shaft (not shown in Fig 1 & 2, see Fig 3) of gearbox 10b, for example, with a set screw (not shown). Driver 90 has a number of protruding fingers, for example, three, which can fit into the matching recesses on the back of actuator 240.

Alternatively, the product reservoir 220 may be formed of a conductive material and used to maintain the product reservoir at a high potential instead of having a separate conductive shield around the reservoir 220. A cartridge insulator 260 can prevent discharge from the conductive product reservoir 220 to points having a lower potential that are in close proximity to the product reservoir 220. The product reservoir 220 can be molded of an electrically conductive material plastic such as acrylonitrile butadiene styrene (ABS) filled with 10% carbon fibers. The cartridge insulator 260 provides an insulating cover to prevent discharge from the conductive product reservoir 220 to objects within the device having lower electrical potentials. In this embodiment, the conductive shield 210 is not required.

A first aspect of this invention relates to a means of mechanically mixing and re-suspending separated material within either product reservoir 220 or within the subsequent product delivery pathway. In a first embodiment, as exampled in Figure 2, one or more mixing balls 290 are placed within product reservoir 220. Disposable cartridge 200 is then shaken by the operator which causes mixing ball 290 to move within product reservoir 220. The movement of mixing ball 290 within product reservoir 220 achieves turbulent mixing of the product within product reservoir 220, thereby reconstituting any separated product. It may be appreciated that the shaking of disposable cartridge 200 may occur while it is either inside or outside of the intended electrostatic spraying device.

In yet another embodiment that provides for product mixing, as exampled in Figure 3, a static mixer 400 is placed in fluid communication between product reservoir 220 and nozzle exit orifice 280. Static mixer 400 is designed such that it creates a high degree of turbulent mixing within the fluid flow path in comparison to a straight fluid flow path. The turbulent mixing achieved within the fluid flow path should reconstitute any separated product. Static mixers 400 include, but are not limited to,:

1. a helical type structure, as exampled in Figure 3, although other geometries may be appreciated;
2. at least one disc 500, as exampled in Figure 4, having at least one hole 510. Disc 500 being inserted within the product flow path. A plurality of discs 500 may be inserted, and more preferably with their holes 510 not being in axial alignment in order to increase turbulent mixing. It may be appreciated that one skilled in the art may change the diameter of holes 510, the location of holes 510, and/or the number of holes 510 in order to alter the degree of turbulent mixing. The diameter of hole 510 in the embodiment of Figure 4 is approximately 0.030" diameter.
3. at least one baffle 600, as exampled in Figure 5, having at least one opening 610. Baffle 600 being inserted within the product flow path. A plurality of baffles 600 may be inserted, more preferably with their openings 610 not being in axial alignment in order to increase turbulent mixing. It may be appreciated that one skilled in the art may change the change the size of baffles 610, the location of baffles 610, and/or the number of baffles 610 in order to alter the degree of turbulent mixing.

In yet another embodiment, as exampled in Figure 6, a prop mixer 700 is added within product reservoir 220 in order to provide product mixing. Prop mixer 700 may take the form of a paddle connected to piston 230. As piston 230 rotates up or down, so does prop mixer 700, thereby creating turbulent mixing within product reservoir 220. It may also be appreciated by one skilled in the art that such prop mixer 700 need not necessarily be attached to a piston 230. Such alternative configurations include, but are not limited to:

1. prop mixer 700 being attached to another rotating member (e.g. threaded shaft 250) within either the product reservoir 220 or subsequent product delivery pathway; or
2. prop mixer 700 is unattached but yet still contained in said disposable so as to allow prop mixer 700 to rotate about a longitudinal axis to said disposable cartridge in response to product flow.

Referring to Figures 7 and 8, a hand-held, self-contained electrostatic spraying device 5 having a disposable cartridge 200 is shown. Disposable cartridge 200 may contain a variety of product, including but not limited to, cosmetics, skin creams, and skin lotions. The product in disposable cartridge 200 may be positively discharged (discussed supra) and powered by gearbox/motor component 10. Gearbox/motor component 10 may be fixed onto a left or first housing 30. The gearbox/motor component 10 can be affixed into place by either mechanically, adhesively, or by any other suitable technique. Gearbox/motor component 10 preferably comprises a precision motor 10a connected to a gearbox 10b. Power source 20 provides power which ultimately operates precision motor 10b. Examples for suitable power source 20 include, but is not limited to, two "AAA" type batteries. The power from power source 20 is channeled through circuit control 60 and high voltage power supply 40, and then to high voltage contact 50 where it comes into contact disposable cartridge 200. High voltage power supply 40 is powered and controlled by control circuit 60 (discussed infra). Power-on switch 80 permits the user to cause an interruption between power source 20 and circuit control 60. Power-on switch 80 is designed such that voltage is supplied to the remainder of the circuit only when switch 80 is in the "ON" or closed position. Apply switch 70 permits the user to selectively activate motor 10a, thereby activating the delivery and spraying of the product. Gearbox/motor component 10 has a driver 90 fastened to a shaft (not shown in Fig 1 & 2, see Fig 3) of gearbox 10b, for example, with a set screw (not shown). Driver 90 has a number of protruding fingers, for example, three, which can fit into the matching recesses on the back of actuator 240.

Yet another aspect of this invention relates to maintaining contact between high voltage contact 850 and conductive shield 210 on disposable cartridge 200. For the class of electrostatic spraying devices with removable/ replaceable product reservoirs, the ability to maintain the high voltage connection between the device itself and the disposable cartridge 200 is paramount for maintaining a consistent, steady state spray. When interruptions exists in the connection between the high voltage contact 850 and conductive shield 210 (or any other similar electrodes), spraying is interrupted and/or an undesirable spray is produced. In one embodiment, as exampled in Figure 1, conductive shield 210 is of substantially circular geometry and has an annular electrode contact portion 300. Annular electrode contact portion 300 improves the intimate contact between the high voltage contact 850 and conductive shield 210 which is particularly important when the product reservoir 220 is rotated or moved within device 5. Such rotation and/or movement results in a period of interrupted supply of the high voltage power source, which leads to interruptions in

spray performance. The addition of annular electrode contact portion 300 helps to minimize this problem. In an alternative design (not shown), it may also be appreciated by one skilled in the art to construct the high voltage contact 850 in a substantially circular geometry in order to achieve similar results. One skilled in the art would appreciate the use of spring biasing to improve contact between the high voltage contact 850 and conductive shield 210, as exampled in Figure 7. In Figure 7, high voltage contact 850 is configured as a 'leaf spring' such that when a disposable cartridge 200 is loaded into device 5, the leaf spring is biased to maintain contact with conductive shield 210. In yet another embodiment which improves the intimate contact between the high voltage contact 850 and conductive shield 210 is shown in Figures 9 and 10, further described below.

Yet another aspect of this invention, as exampled in Figures 9 and 10, is incorporating both locking and ejection features into disposable cartridge 200 and spraying device 805. In this embodiment, a catch mechanism 1020 is used to secure disposable cartridge 200 into insert sleeve 910 at a clasp location 1010. Catch mechanism 1020 also provides a positive tactile and audible signal to the user that disposable cartridge 200 is properly installed within device 5. Locking mechanism 1000 consists of actuator button 1050, locking slide 1030 and locking spring 1040. Locking mechanism 1000 may be connected to the underside of disposable cartridge 200 or any other suitable location. Locking slide 1030 is biased in the "UP" position by locking spring 1040. When a disposable cartridge 200 is installed, locking slide 1030 is moved down and disposable cartridge 200 is placed within insert sleeve 910. When disposable cartridge 200 is completely within insert sleeve 910, locking slide 1030 will slip into locking lug 310 (shown in Figure 1), thereby causing an audible click and securely locking disposable cartridge 200 inside of insert sleeve 910. Actuator 240 moves electrode cover 1070 in the same direction of disposable cartridge 200 insertion, thereby exposing high voltage contact 850 (not shown in Figure 10) inside of device 5. Electrode cover 1070 may be mounted within and guided back by slide channel 1080. While moving back, electrode cover 1070 compresses bias spring 1060. When a user desires to remove disposable cartridge 200 from insert sleeve 910, the user actuates actuator button 1050 to move locking slide 1030 down, thereby disengaging it from locking lug 310. Disposable cartridge 200 is then moved forward within insert sleeve 910 by the decompression of bias spring 1060. The user can then finish removing disposable cartridge 200 from device 5. Once installed and secured in place, locking mechanism 1000 will prevent disposable cartridge 200 from being inadvertently removed through shaking and handling of device 5 during usage and storage.

Having shown and described the preferred embodiments of the present invention, further adaptions of the present invention as described herein can be accomplished by appropriate modifications by one of ordinary skill in the art without departing from the scope of the present invention. Several of these potential modifications and alternatives have been mentioned, and others will be apparent to those skilled in the art. For example, while exemplary embodiments of the present invention have been discussed for illustrative purposes, it should be understood that the elements described will be constantly updated and improved by technological advances. Accordingly, the scope of the present invention should be considered in terms of the following claims and is understood not to be limited to the details of structure, operation or process steps as shown and described in the specification and drawings.

Incorporation by reference:

Relevant electrostatic spray devices and cartridges are described in the following commonly-assigned, concurrently-filed U.S. Patent Applications, and hereby incorporated by reference:

"Electrostatic Spray Device", which is assigned Attorney Docket No. 8394.
"Electrostatic Spray Device", which is assigned Attorney Docket No. 8395.
"Electrostatic Spray Device", which is assigned Attorney Docket No. 8396.

What is claimed is:

1. A cartridge configured to contain and deliver a product for use with an electrostatic spray device characterized by:

a reservoir configured to contain the product;

a nozzle to disperse the product, said nozzle having an exit orifice;

a channel disposed between said reservoir and said nozzle, wherein said channel permits the electrostatic charging of the product upon said product moving within said channel;

a high voltage contact for receiving power from the electrostatic device;

a high voltage electrode electrically connected to said high voltage contact, said high voltage electrode being configured to charge the product for dispersal from said nozzle;

a high voltage shield substantially surrounding said reservoir, said high voltage shield being conductive.

a mixing mechanism disposed between said reservoir and said nozzle, said mixing mechanism being in fluid communication with the product, whereby said mixing mechanism reconstitutes the product.

2. The cartridge of Claim 1, wherein said mixing mechanism is at least one mixing ball.

3. The cartridge of Claim 1, wherein said mixing mechanism is at least one static mixer.

4. The cartridge of Claim 1, wherein said mixing mechanism is at least one disc having at least one hole.

5. The cartridge of Claim 4, wherein a plurality of said discs are arranged such that their respective holes are not axially aligned in order to increase turbulent mixing.

6. The cartridge of Claim 4, wherein said hole has a diameter of approximately 0.030 inches.

7. The cartridge of Claim 1, wherein said mixing mechanism is at least one baffle having at least one opening.

8. The cartridge of Claim 7, wherein a plurality of said baffles are arranged such that their respective opening are not axially aligned in order to increase turbulent mixing.

9. An electrostatic spraying device being configured and disposed to electrostatically charge and dispense a product from a supply to a point of dispersal, said device characterized by:

a reservoir configured to contain the supply of product;

a nozzle to disperse the product, said nozzle being disposed at the point of dispersal; said nozzle having an exit orifice;

a channel disposed between said reservoir and said nozzle, wherein said channel permits the electrostatic charging of the product upon said product moving within said channel;

a mechanism to move the product from said reservoir to said nozzle;

a power source to supply an electrical charge;

a high voltage power supply, said high voltage power supply being electrically connected to said power source;

a high voltage contact; said high voltage contact being electrically connected to said high voltage power supply; and

a high voltage electrode, said high voltage electrode being electrically connected to said high voltage power supply, a portion of said high voltage electrode being disposed between said reservoir and said nozzle, said high voltage electrode electrostatically charges the product within said channel at a charging location,

wherein said high voltage contact is spring biased in direction towards said high voltage electrode.

10. A cartridge configured to contain and deliver a product for use with an electrostatic spray device characterized by:

a reservoir configured to contain the product;

a nozzle to disperse the product, said nozzle having an exit orifice;

a channel disposed between said reservoir and said nozzle, wherein said channel permits the electrostatic charging of the product upon said product moving within said channel;

a high voltage contact for receiving power from the electrostatic device;

a high voltage electrode electrically connected to said high voltage contact, said high voltage electrode being configured to charge the product for dispersal from said nozzle;

a high voltage shield substantially surrounding said reservoir, said high voltage shield being conductive.

wherein said high voltage electrode is annular.

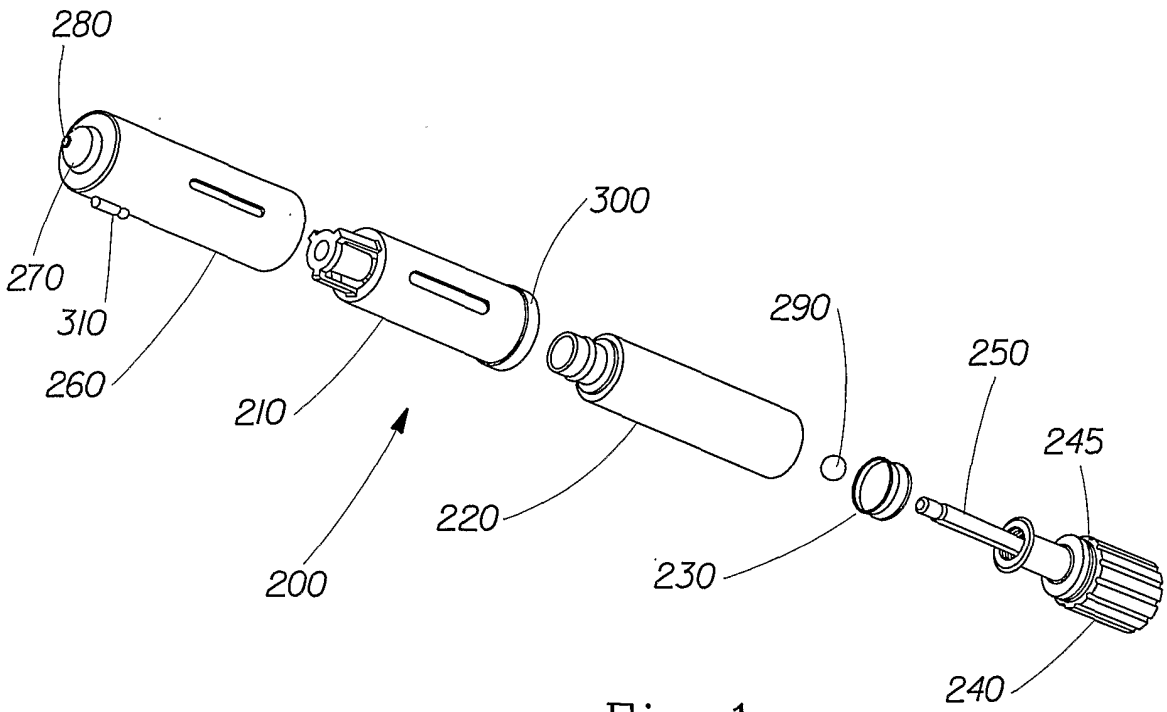


Fig. 1

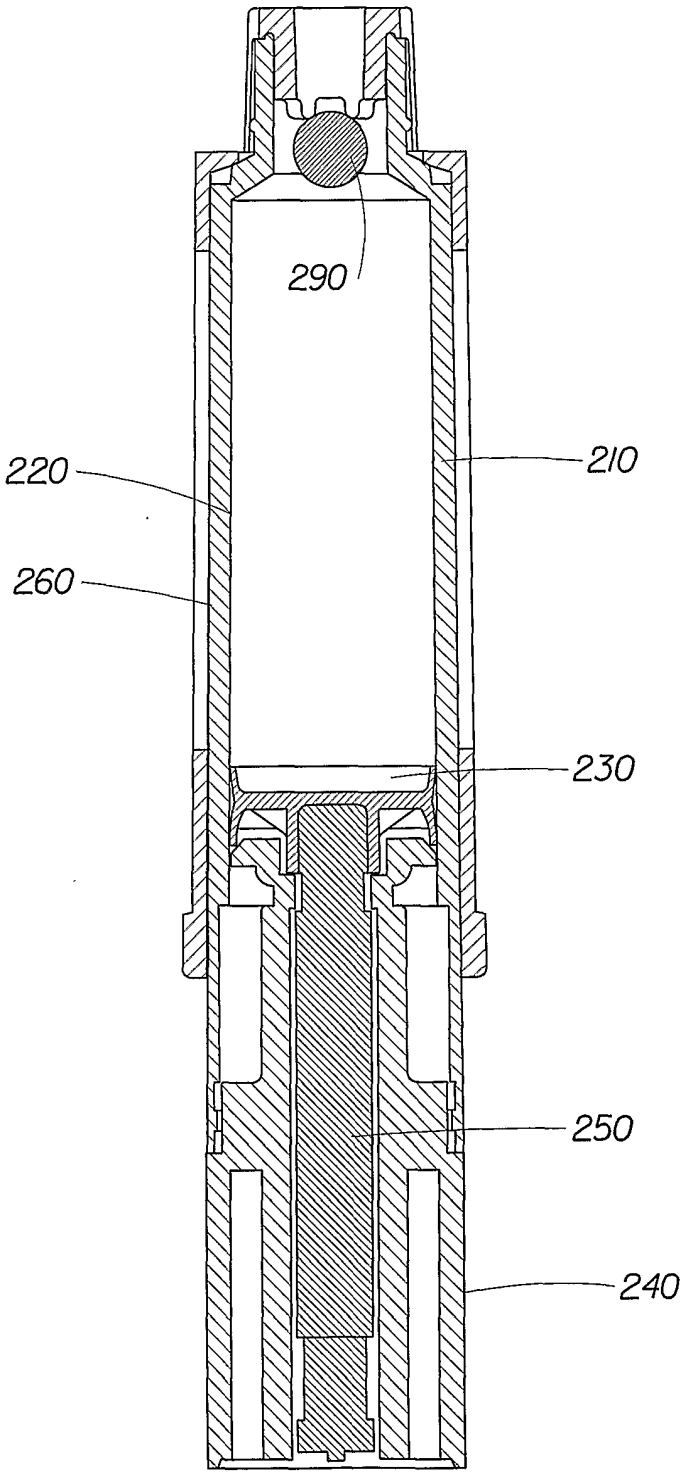


Fig. 2

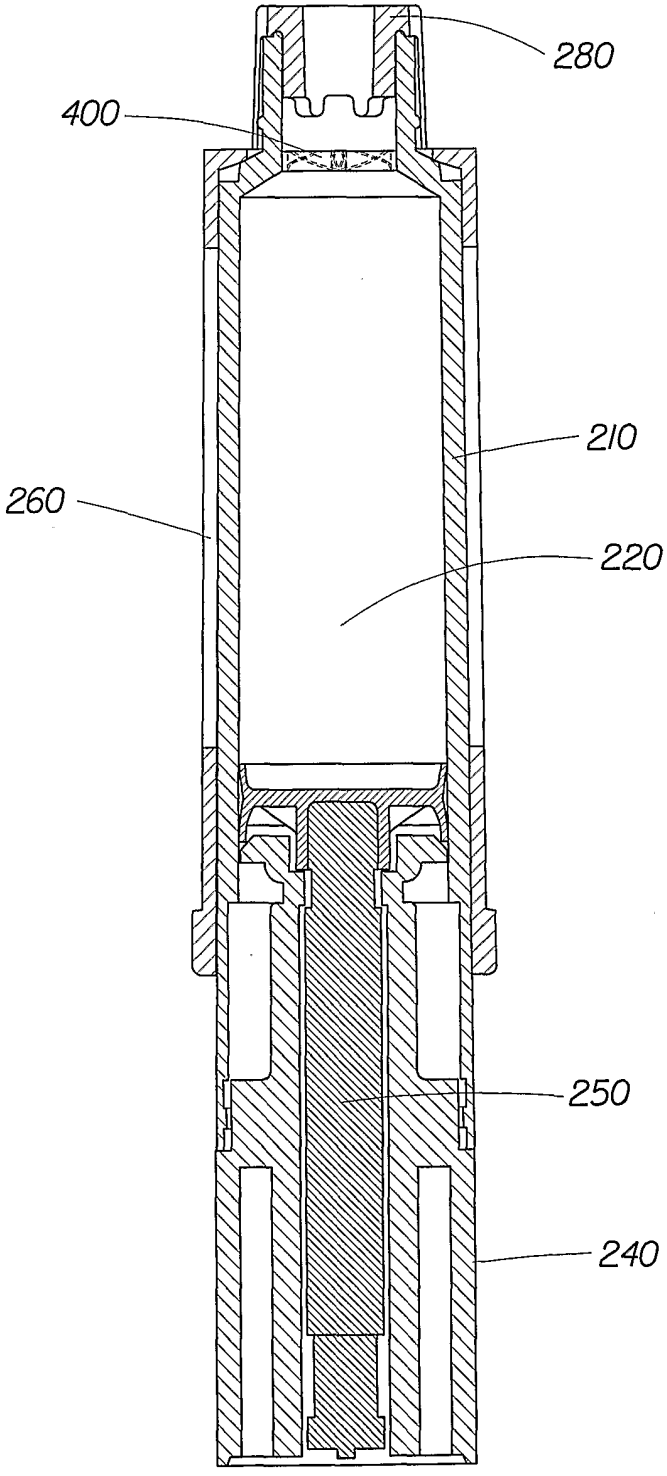


Fig. 3

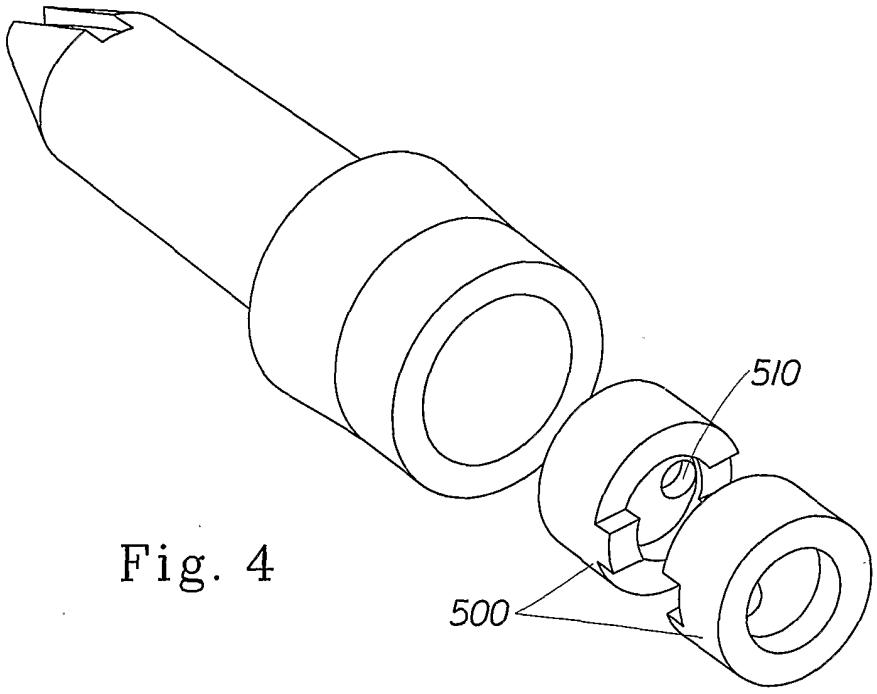


Fig. 4

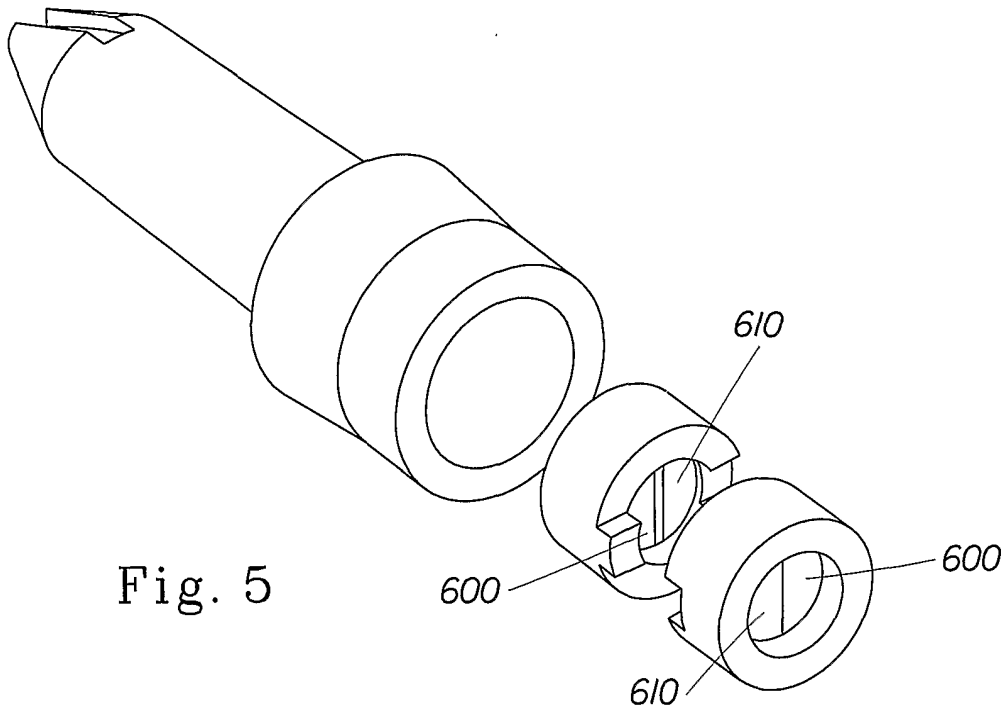


Fig. 5

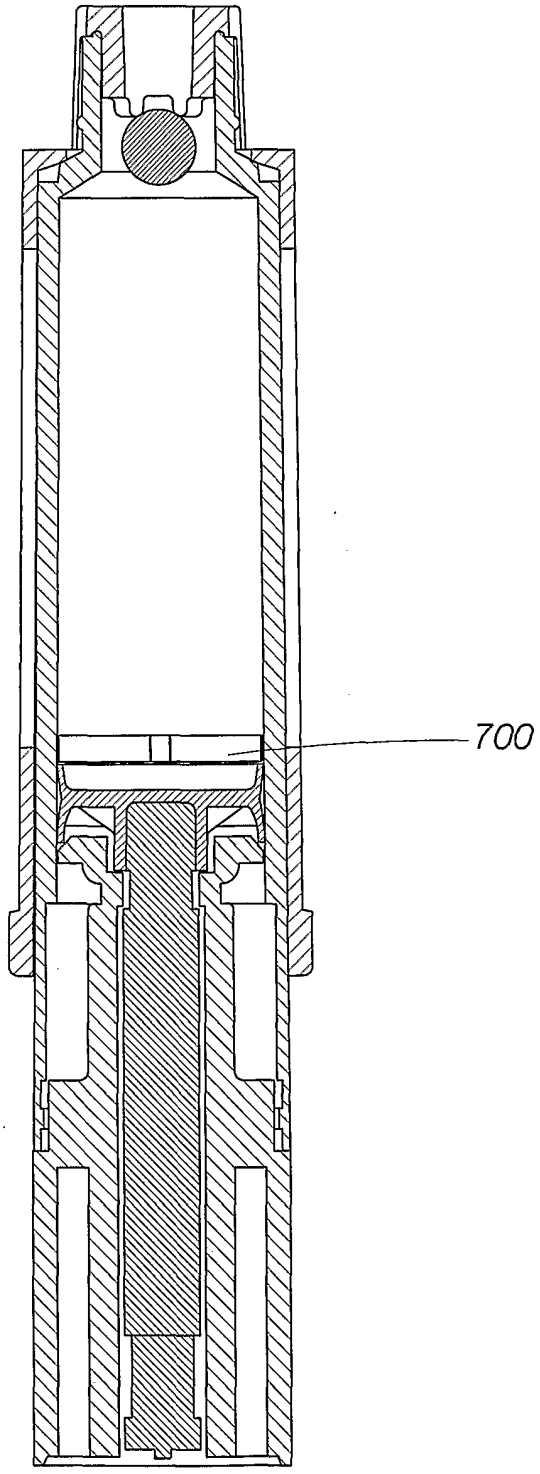


Fig. 6

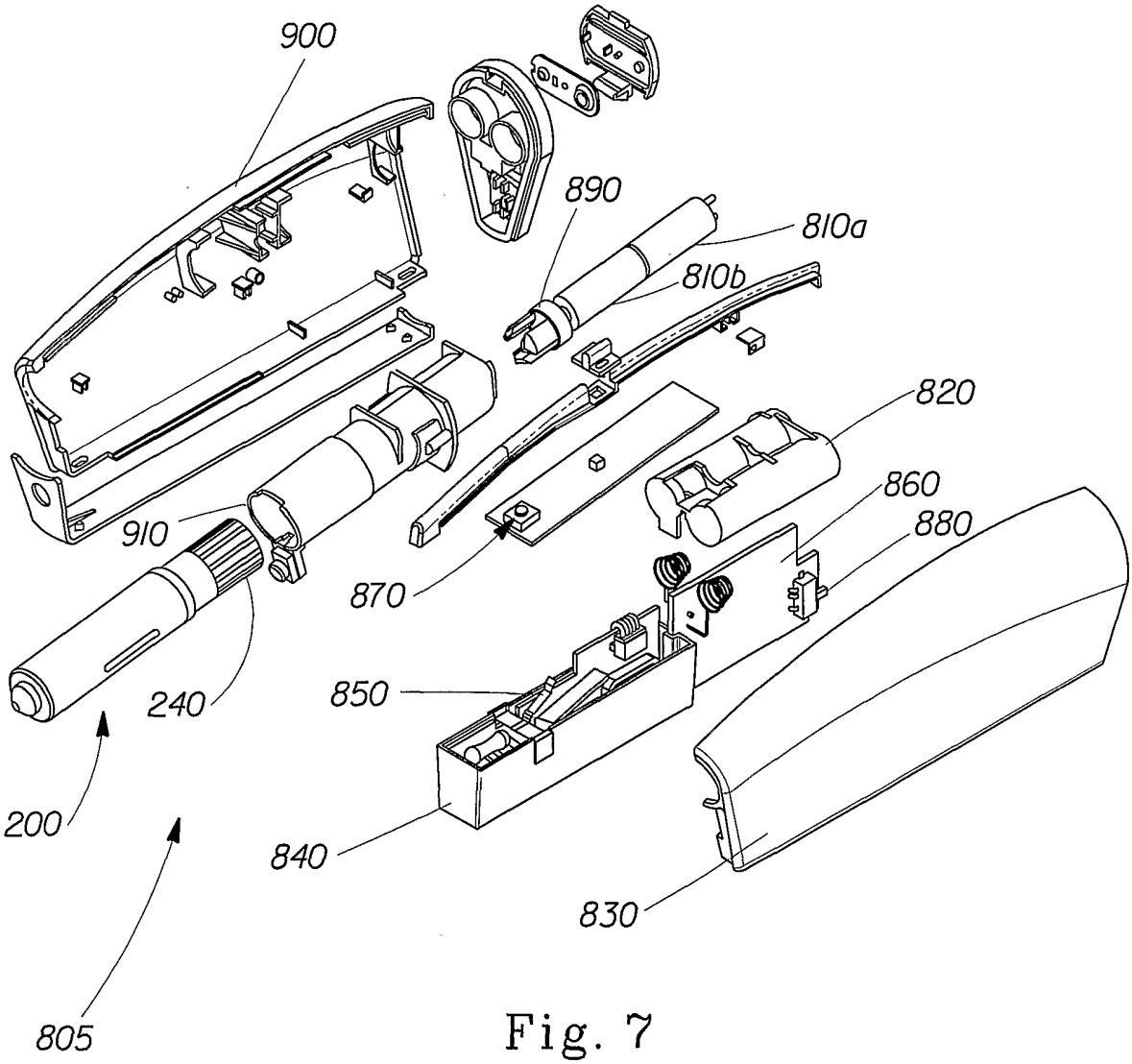


Fig. 7

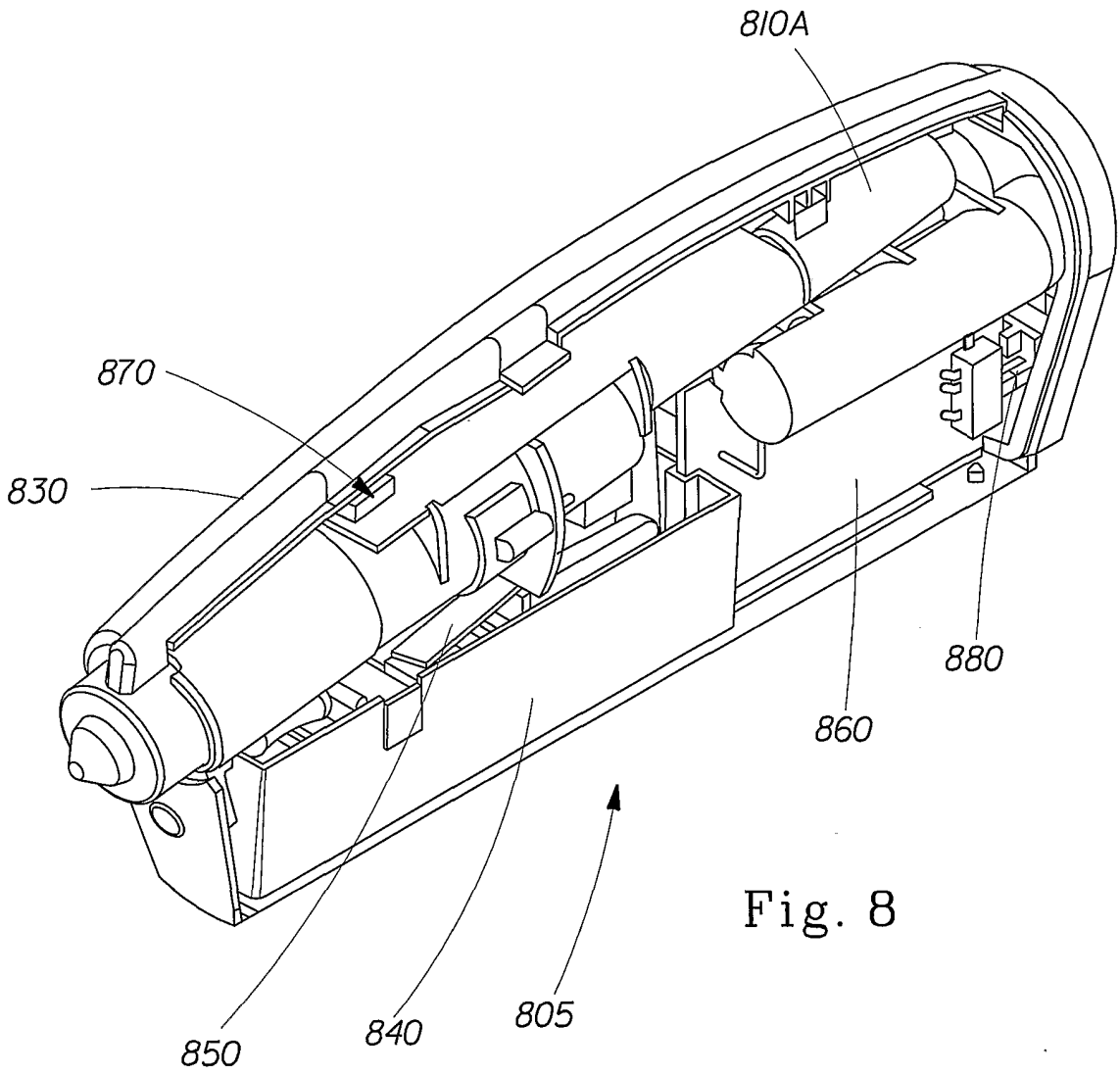


Fig. 8

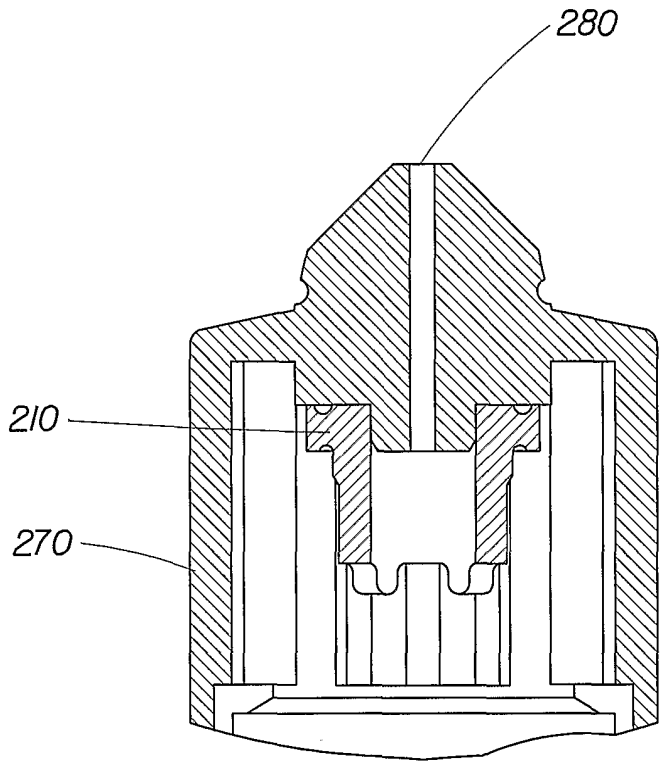


Fig. 9

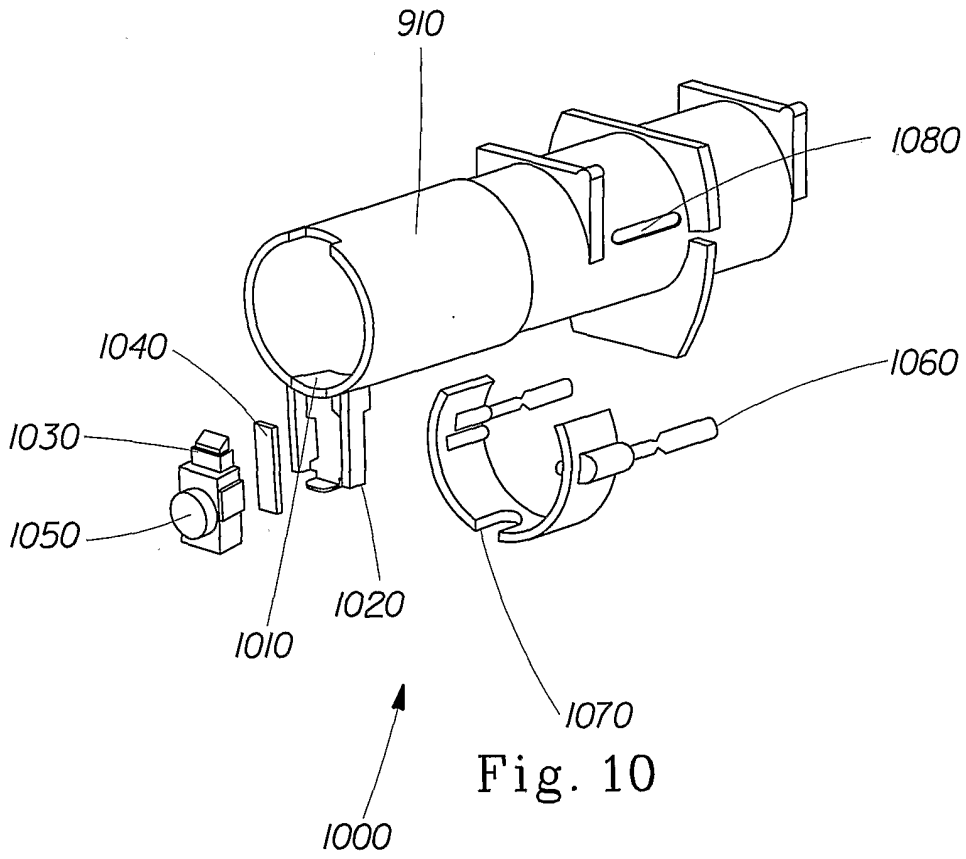


Fig. 10

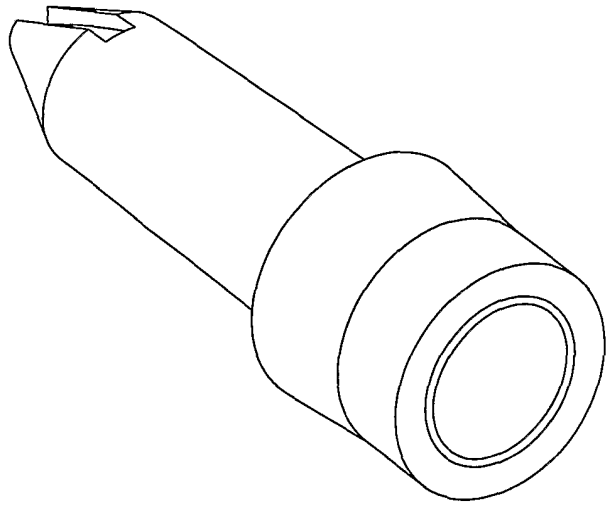


Fig. 11