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(71) Applicant (for all designated States except US): **COOK VASCULAR INCORPORATED** [US/US]; P.O. Box 529, Route 66, River Road, Leechburg, PA 15656 (US).

(72) Inventors: **BOOKER, Robert**; 1164 Booker Lane, Vandergrift, PA 15690 (US). **ARABIA, Dustin John**; 216 McLaughlin Drive, New Kensington, PA 15068 (US). **MAGALICH, Christopher Nick**; 357 3rd Avenue, Avommore, PA 15618 (US).

(74) Agent: **STEWART, Lawrence, A.**; Brinks Hofer Gilson & Lione, One Indiana Square, Suite 1600, Indianapolis, IN 46204 (US).

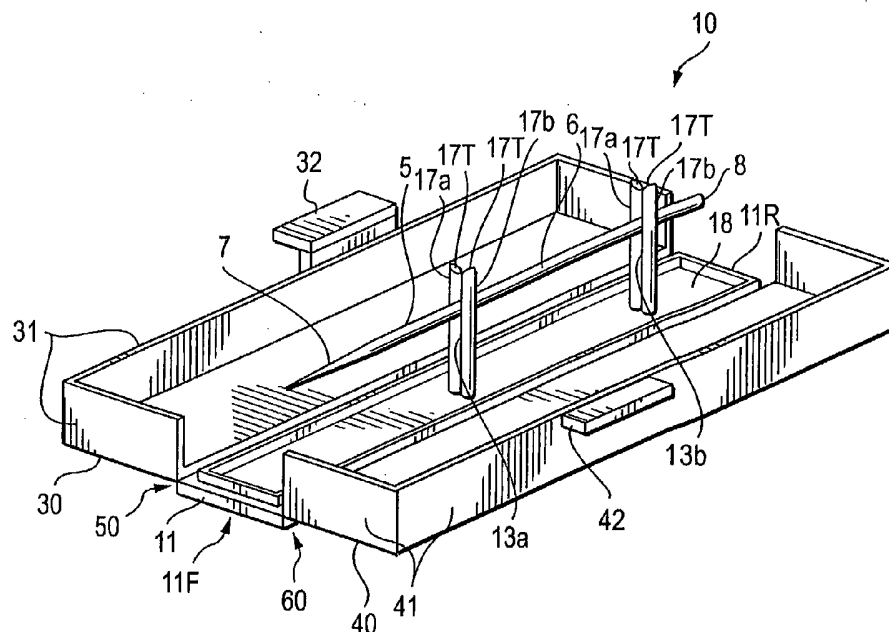
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(54) Title: MICROPIPETTE HOLDER



(57) Abstract: A device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising: a base portion, a side-portion and at least one living hinge interconnecting the side-portion to the base portion. The base portion comprises a plurality of recesses on a surface, each recess being delimited by a plurality of pins, each pin having an indentation. The plurality of indentations form a pocket by which the tubular element is held. The at least one living hinge opens such that the side-portion is substantially parallel to the base portion in the open configuration and the at least one living hinge closes such that the side-portion forms a protective shell about the base portion in the closed configuration.

## MICROPIPETTE HOLDER

### BACKGROUND

[0001] 1. Technical Field. This invention relates to a protective packaging, and more particularly to a protective packaging for transport and storage of a tubular element including, but not limited to, a capillary tube or a micropipette.

[0002] 2. Background Information. In general, capillary tubes are very fragile thin tubes of very small diameter made from a brittle material such as glass for example. Typically, extreme caution is needed to transport, store, grip and use capillary tubes due to their fragility, which is due to, at least in part, the nominal dimensions of the device. For example, the ratio of the external diameter of the capillary tube to its length can be on the order of 100 or more. Indeed, capillary tubes having an external diameter of about 1mm or less and a length of about 10 cm or more are commonplace.

[0003] Micropipettes are one non-limiting example of a medical device whose nominal dimensions substantially correspond to those described above. Referring to Figure 5, a micropipette 5 typically comprises a main portion 6 of constant diameter and a tapered portion 7 that ends in a tip. The tapered portion provides an extension in which its internal diameter is reduced to a value of about 5 to about 30 microns. Thus, the internal diameter of the tapered portion and tip are approximately a dimension of 10,000 times less than that of the length of the tube and to the order of 200 relative to its external diameter in the main portion of the micropipette. Micropipettes are particularly useful for in vitro fertilization techniques such as intracytoplasmic sperm injection (ICSI). During this procedure, a spermatozoon is picked-up using the tip of the micropipette. The micropipette tip is then used to puncture the zona pellucida and vitelline membrane to inject the sperm into the oocyte cytoplasm. The tip of the micropipette ensures that the device is as non-traumatic to the reproductive tissues as possible. A separate micropipette also may be used to retain the oocyte into which the first micropipette delivers the sperm.

[0004] From the foregoing, it can be appreciated that such tubular elements require the greatest care continuously, not only during the operations associated with their use, but also during their transport and storage. For these reasons, a packaging device that provides support and protects the tubular element against shock and flexure, even the slightest of which would unmendably break it, which is easy to grasp and to move by the user, easy to use when the tubular element is positioned therein or withdrawn therefrom, inexpensive to manufacture and, finally, small in size is needed.

#### BRIEF SUMMARY

[0005] In one aspect, the invention is a device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising: a base portion, a side-portion and at least one living hinge interconnecting the side-portion to the base portion. The base portion comprises a plurality of recesses on a surface, each recess being delimited by a plurality of pins, each pin having an indentation. The plurality of indentations form a pocket by which the tubular element is held. The at least one living hinge opens such that the side-portion is substantially parallel to the base portion in the open configuration and the at least one living hinge closes such that the side-portion forms a protective shell about the base portion in the closed configuration.

[0006] In yet another aspect, the invention is a device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising: a base portion, a first side-portion and a second side-portion. The first and second side-portions are interconnected to the base portion by at least one first living hinge and at least one second living hinge, respectively. The base portion comprises a plurality of recesses on a surface. The plurality of recesses is centered within the device and spaced apart from each other. Each recess is delimited by a plurality of pins and each pin has an indentation. The plurality of indentations form a pocket by which the tubular element is held. The at least one first living hinge and the at least one second living hinge open such that the first and second side-portions are

substantially parallel to the base portion in the open configuration and the at least one first living hinge and the at least one second living hinge close such that the first and second side-portions form a protective shell about the base portion in the closed configuration.

[0007] In yet another aspect, the invention is a device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising: a base portion, a first side-portion and a second side-portion. The first and second side-portions are interconnected to the base portion by at least one first living hinge and the at least one second living hinge, respectively. The base portion comprises on a surface an alignment pin and two recesses. The alignment pin is positioned at a rear-end of the base portion and the two recesses are centered within the device and spaced apart from each other. Each recess is delimited by a first pin and a second pin. The first pin and the second pin have a first and second indentation, respectively. Each of the first second indentations comprises a generally semi-circular configuration such that the first and second indentations form a pocket comprising a generally circular configuration by which the tubular element is held. Each of the first and second pins comprises a tapered top portion and at least one of the first and second pins is formed from an elastic material. The first side-portion comprises a first outer-edge having a first-half of a locking mechanism and the second side-portion comprises a second outer-edge having a second-half of the locking mechanism. The at least one first living hinge and the at least one second living hinge open such that the first and second side-portions are substantially parallel to the base portion in the open configuration. The at least one first living hinge and the at least one second living hinge close such that the first side-portion, the second side-portion, the first outer-edge, the second outer-edge and the base portion form a protective shell about the tubular element and the first-half of the locking mechanism engages the second-half of the locking mechanism in the closed configuration.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 is a perspective view of a device for support and protection of a tubular element in an open configuration with a tubular element supported therein according to an embodiment of the present invention.

[0009] Figure 2 is a perspective view of a device for support and protection of a tubular element in an open configuration with a tubular element supported therein according to an alternate embodiment of the present invention.

[0010] Figure 3 is an end view of the device of Figure 2.

[0011] Figure 4 is an end view of the device of Figure 2 in a closed configuration.

[0012] Figure 5 is a perspective view of the tubular element of Figures 1 and 2, the tubular element having a tapered portion and a main portion of constant nominal diameter.

[0013] Figure 6 is an enlarged, cross-sectional view of a living hinge of the device of Figures 1 and 2.

[0014] Figure 7 is a perspective view of a device for support and protection of a tubular element in an open configuration with a tubular element supported therein according to an another alternate embodiment of the present invention.

[0015] Figure 8 is a perspective view of the device of Figure 7 in a closed configuration.

[0016] Figure 9A is a top view of a recess formed from three pins according to one embodiment of the present invention.

[0017] Figure 9B is an end view of the recess and pin configuration of Figure 9A.

[0018] Figure 9C is an end view of the recess and pin configuration of Figure 9A retaining a tubular element.

## DETAILED DESCRIPTION OF THE DRAWINGS AND THE PRESENTLY PREFERRED EMBODIMENTS

[0019] Referring to the drawings wherein like reference numerals represent like parts throughout, reference numeral 10 is directed to a device for support and

protection of a tubular element 5. The device 10 comprises a single-piece construction having an open configuration (shown in Figures 1-3 and 7) and a closed configuration (shown in Figures 4 and 8). Optionally, the single-piece construction of the device 10 is molded from plastic. The device further comprises a base portion 11, a side-portion 30 and a living hinge 50 interconnecting the base portion 11 and the side portion 30. The living hinge 50 enables the side portion 30 to be moved relative to the base portion 11. More specifically, in the open configuration, the living hinge 50 is open such that the side-portion 30 is substantially parallel to the base portion 11, as shown in Figures 1-3 and 7, and in the closed configuration, the living hinge 50 is closed such that the side portion 30 forms a protective shell about the base portion, as shown in Figures 4 and 8.

**[0020]** Optionally, as shown in the embodiment of Figures 1-4, the device 10 further includes a second side-portion 40 and a second living hinge 60 interconnecting the base portion 11 and the second side-portion 40. Living hinge 60 enables the second side-portion 40 to be moved relative to the base portion 11. More specifically, in the open configuration, the living hinge 60 is open such that the second side-portion 40 is substantially parallel to the base portion 11, as shown in Figures 1-3 and 7, and, in the closed configuration, the living hinge 60 is closed such that the second side-portion 40 forms a protective shell about the base portion, as shown in Figures 4 and 8.

**[0021]** The base portion 11 comprises a plurality of recesses 13. By way of a non-limiting example, the base portion 11 comprises a first and a second recess 13a, 13b, respectively, on an interior surface 18. Optionally, the plurality of recesses are centered within the device but spaced apart from each other. Each recess 13 is delimited by a plurality of pins 17. Each pin 17 is perpendicular to the base portion 11 and comprises an indentation 12. The plurality of indentations 12 associated with each recess forms a pocket 16 by which the tubular element 5 is held as best seen in Figures 9B-C. At least one of the plurality of pins is flexible to allow for the insertion and removal of the tubular element 5 while still returning

to its original orientation. Optionally, each pin 17 comprises a tapered top-portion 17T to facilitate the insertion and the removal of the tubular element 5.

**[0022]** Turning to the embodiment shown in Figures 1-3, each recess 13a, 13b is delimited by a first pin 17a having a first indentation 12a and a second pin 17b having a second indentation 12b. The first and second indentations 12a, 12b each comprise a semi-circular configuration to form a pocket 16 having a generally circular configuration.

**[0023]** Alternatively, each recess 13 can be delimited by a greater number of pins. For example, in the embodiment of Figure 7, each recess 13a, 13b is delimited by a first pin 17a, a second pin 17b and a third pin 17c. The first, second and third indentations 12a, 12b, 12c associated with each recess 13a, 13b each comprise a semi-circular configuration to form a pocket 16 having a generally circular configuration.

**[0024]** It is believed that a pocket 16 having a generally circular configuration distributes the stress imparted by the pins 17 to the tubular element 5 evenly along the generally circular contour of the tubular element 5. For this reason, a pocket 16 having a generally circular configuration imparts the least amount of stress to the tubular element also having a generally circular contour held therein. However, any other suitable configuration can be used for the indentation including grooves, notches or other various shapes.

**[0025]** Each pin 17 can be uniform in size and thickness, as shown in Figure 1-3, or the thickness of the pins can vary as shown in Figures 9A-C. Optionally, the thickness of the pins can also taper from the base of the pin to the top of the pin, as shown in Figures 9B and 9C. By altering the thickness of the pins, the flexibility of the pins can be varied. In general, reducing the thickness of the pin increases the flexibility of the pin. As the flexibility of the pin increases, the ease in which the tubular member can be inserted and removed from the recess also increases. Turning to Figures 9A-9C, there is shown a top view and an end view of a recess formed from three pins 17a, 17b and 17c. In this embodiment, the thickness 22b of the center pin 17b is less than the thickness 22a, 22c of each end pin 17a and 17c. Thus, the center pin 17b is more flexible than the end pins 17a and 17c. In

addition, the thickness 22 of the pins 17 decreases from the base of the pin to the top of the pin. Thus, each pin is more flexible towards the top of the pin than the base of the pin.

[0026] Optionally, as shown in Figures 1 and 2, the tubular element 5 is positioned within the recesses 13 such that its tapered portion 7 is directed towards a front-end base portion 11F.

[0027] Optionally, as best seen in Figures 2 and 7, the device 10 further includes an alignment structure 20 positioned at a rear end of the base portion 11R to align the tubular element 5 between the plurality of recesses. The alignment structure 20 is perpendicular to the base portion 11 as well as a proximal end 8 of the tubular element 5. The alignment structure 20 can have any suitable shape and several shapes have been contemplated for the alignment structure 20 including, but not limited to, a pin, as shown in Figure 2, or a wall, as shown in Figure 7.

[0028] Referring to the embodiment shown in Figures 1-4, the first and second side-portions 30, 40 are interconnected to the base portion 11 by the first and second living hinges 50, 60, respectively. In the open configuration, the first and second side-portions 30, 40 are substantially parallel to the base portion 11 as shown in Figures 1-3. In the closed configuration, the first and second side-portions 30, 40 form a protective shell 45 about the tubular element 5 as shown in Figure 4. Figure 4 depicts the first and second side-portions 30, 40 raised and substantially perpendicular to the base portion 11.

[0029] Optionally, the first side-portion and the second side-portion 30, 40 comprise a first outer-edge 31 and a second outer-edge 41, respectively, which together with the base portion 11 form the protective shell about the tubular element 5 in the closed configuration. Also optionally, the first and second side-portions 30, 40 are configured to form an interference fit with each other in the closed configuration, as shown in Figures 1-4. For example, the first side-portion 30 comprises a first-half of a locking mechanism 32 and the second side-portion 40 comprises the second-half of the locking mechanism 42, as shown in Figures 1-3. The first-half of the locking mechanism 32 is capable of engaging the second-

half of the locking mechanism 42 in the closed configuration, as shown in Figure 4.

[0030] Referring to the embodiment shown in Figure 7, the side-portion 30 is interconnected to the base portion 11 by a single living hinge 50. In the open configuration, the side-portion 30 is substantially parallel to the base portion 11 as shown in Figure 7. In the closed configuration, the side-portion 30 is raised and lowered about the base portion 11 such that the side-portion 30 and the base portion 11 form a protective shell 45 about the tubular element, as shown in Figure 8. Figure 7 shows the side-portion 30 and the base portion 11 can be formed with a side outer-edge 31 and a base outer-edge 21, respectively.

[0031] Optionally, the side-portion 30 and the base portion 11 are configured to form an interference fit with each other. For example, Figure 7 shows one possible arrangement wherein an interior surface of the side-portion 30 comprises a first-half locking mechanism 32 and an interior surface of the base portion 11 comprises a second-half locking mechanism 42. Those skilled in the art will appreciate that other known elements can also be arranged to form an interference fit, and locking mechanisms 32, 42 are merely examples of numerous other possible arrangements which are considered within the scope of the invention.

[0032] Although, the figures depict the protective shell 45 to be rectangular in contour, the protective shell 45 can have any suitable contour. For example, if the side-portions 30, 40 and the base portion 11 were elliptical rather than rectangular, then the protective shell 45 would be elliptical in contour in the closed configuration.

[0033] The first and second living hinges 50, 60 comprise thin sections of material; such as plastic, that connect the first and second side-portions 30, 40 with the base portion 11, respectively. The first living hinge 50 keeps the first side-portion 30 together with the base portion 11 and allows the first side-portion 30 to be moved relative to the base portion 11. Likewise, the second living hinge 60 keeps the second side-portion 40 together with the base portion 11 and allows the second side-portion 40 to be moved relative to the base portion 11. The materials used to make a living hinge are usually a very flexible plastic such as

polypropylene and polyethylene. These materials can flex more than a million cycles without failure.

**[0034]** Figure 6 shows one exemplary configuration of a living hinge 50. Since the first living hinge 50 and the second living hinge 60 are substantially the same, reference will be made to only the first living hinge 50. The living hinge 50 comprises an interior hinge surface 51, an exterior hinge surface 52 and a living hinge thickness 55. The living hinge thickness 55 ranges from about 0.007 in. to about 0.015 in.

**[0035]** Although the figures show the first side-portion 30 attached to the base portion 11, by a single first living hinge 50 extending substantially along the length the first side-portion 30, a plurality of first living hinges 50 spaced apart from each other can also be used. For example, two first living hinges 50 can be spaced apart from each other along the length of the first side-portion 30. Similarly, the second side-portion 40 can be attached to the base portion 11 by a plurality of second living hinges 60 spaced apart from each other along the length of the second side-portion 40.

**[0036]** It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that it be understood that it is the following claims, including all equivalents, that are intended to define the spirit and scope of this invention.

## CLAIMS

1. A device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising:
  - a base portion, a side-portion and at least one living hinge interconnecting the side-portion to the base portion; the base portion comprising a plurality of recesses on a surface, each recess being delimited by a plurality of pins, each pin having an indentation, the plurality of indentations forming a pocket by which the tubular element is held;
  - wherein the at least one living hinge opens such that the side-portion is substantially parallel to the base portion in the open configuration; and
  - wherein the at least one living hinge closes such that the side-portion forms a protective shell about the base portion in the closed configuration.
2. The device of claim 1, wherein each indentation comprises a generally semi-circular configuration such that the pocket comprises a generally circular configuration.
3. The device of claim 1, wherein at least one pin comprises an elastic material.
4. The device of claim 1, wherein each pin comprises a tapered top-portion.
5. The device of claim 1 further comprising an alignment structure attached to a rear-end of the base portion.
6. The device of claim 1, wherein the plurality of recesses are centered within the device.
7. The device of claim 1, wherein the plurality of recesses are spaced apart from each other.

8. The device of claim 1 further comprising a second side-portion and at least one second living hinge interconnecting the second side-portion to the base portion;

wherein the at least one second living hinge opens such that the second side-portion is substantially parallel to the base portion in the open configuration; and

wherein the at least one second living hinge closes such that the second side-portion forms a protective shell about the base portion in the closed configuration.

9. The device of claim 8, wherein the side-portion and the second side-portion are configured to form an interference fit with each other in the closed configuration.

10. The device of claim 8, wherein the side-portion comprises a first-half of a locking mechanism and the second side-portion comprises a second-half of the locking mechanism, the first-half locking mechanism being capable of engaging the second-half of the locking mechanism in the closed configuration.

11. The device of claim 1, further comprising an alignment structure attached to a rear-end of the base portion, the plurality of recesses being centered within the device and spaced apart from each other, wherein each pin comprises a tapered top-portion and at least one pin is formed from an elastic material, and wherein the base portion and the side portion are configured to form an interference fit with each other in the closed configuration.

12. The device of claim 11, wherein said plurality of recesses comprises first and second recesses, and wherein said plurality of pins comprises a first pin, a second pin, and a third pin, each of said first, second and third pins having a first indentation, a second indentation and a third indentation, respectively, each of the first, second and third indentations forming said pocket; the side-portion

comprising a side outer-edge and a first-half of a locking mechanism, and the base portion comprising a base outer-edge and a second-half of the locking mechanism; and wherein the at least one living hinge closes such that the side-portion, the side outer-edge, the base portion and the base outer-edge forms said protective shell about the tubular element and the first-half of the locking mechanism engages the second-half of the locking mechanism in the closed configuration.

13. A device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising:

a base portion, a first side-portion and a second side-portion; the first and second side-portions being interconnected to the base portion by at least one first and at least one second living hinge, respectively; the base portion comprising a plurality of recesses on a surface, the plurality of recesses being centered within the device and spaced apart from each other, each recess being delimited by a plurality of pins, each pin having an indentation, the plurality of indentations forming a pocket by which the tubular element is held;

wherein the at least one first and at least one second living hinges open such that the first and second side-portions are substantially parallel to the base portion in the open configuration; and

wherein the at least one first and at least one second living hinges close such that the first and second side-portions form a protective shell about the base portion in the closed configuration.

14. The device of claim 13, wherein each pin comprises a tapered top-portion.

15. The device of claim 13, wherein at least one pin comprises an elastic material such that at least one of the plurality of pins is capable of flexing relative to the other of the plurality of pins.

16. The device of claim 13, wherein the first and second side-portions are configured to form an interference fit with each other in the closed configuration.

17. The device of claim 13, wherein the first side-portion comprises a first-half of a locking mechanism and the second side-portion comprises a second-half of the locking mechanism, the first-half locking mechanism being capable of engaging the second-half of the locking mechanism in the closed configuration.

18. The device of claim 13, wherein the first side-portion comprises a first outer-edge and the second side-portion comprises a second outer-edge, wherein the first side-portion, the second side-portion, the first outer-edge, the second outer-edge and the base portion are configured to form a box about the tubular element in the closed configuration.

19. The device of claim 13, wherein each pin comprises a tapered top-portion and at least one pin is formed from an elastic material, and wherein the first side-portion and the second side-portion are configured to form an interference fit with each other in the closed configuration.

20. A device for support and protection of a tubular element having a single-piece construction, an open configuration and a closed configuration, comprising:

a base portion, a first side-portion and a second side-portion-portion; the first and second side-portions are interconnected to the base portion by at least one first and at least one second living hinge, respectively;

the base portion comprising on a surface an alignment pin and two recesses, the alignment pin being positioned at a rear-end of the base portion, the two recesses being centered within the device and spaced apart from each other, each recess being delimited by a first pin and a second pin, the first pin and the second pin having a first and a second indentation, respectively, each of the first and second indentations comprising a generally semi-circular configuration such

that the first and the second indentations form a pocket comprising a generally circular configuration by which the tubular element is held, each of the first and the second pins comprising a tapered top portion and at least one of the first and the second pins is formed from an elastic material;

the first side-portion comprising a first outer-edge, the first outer-edge comprising a first-half of a locking mechanism; and the second side-portion comprising a second outer-edge, the second outer-edge comprising a second-half of the locking mechanism;

wherein the at least one first and the at least one second living hinges open such that the first and second side-portions are substantially parallel to the base portion in the open configuration; and

wherein the at least one first and at least one second living hinges close such that the first side-portion, the second side-portion, the first outer-edge, the second outer-edge and the base portion form a protective shell about the tubular element and the first-half of the locking mechanism engages the second-half of the locking mechanism in the closed configuration.

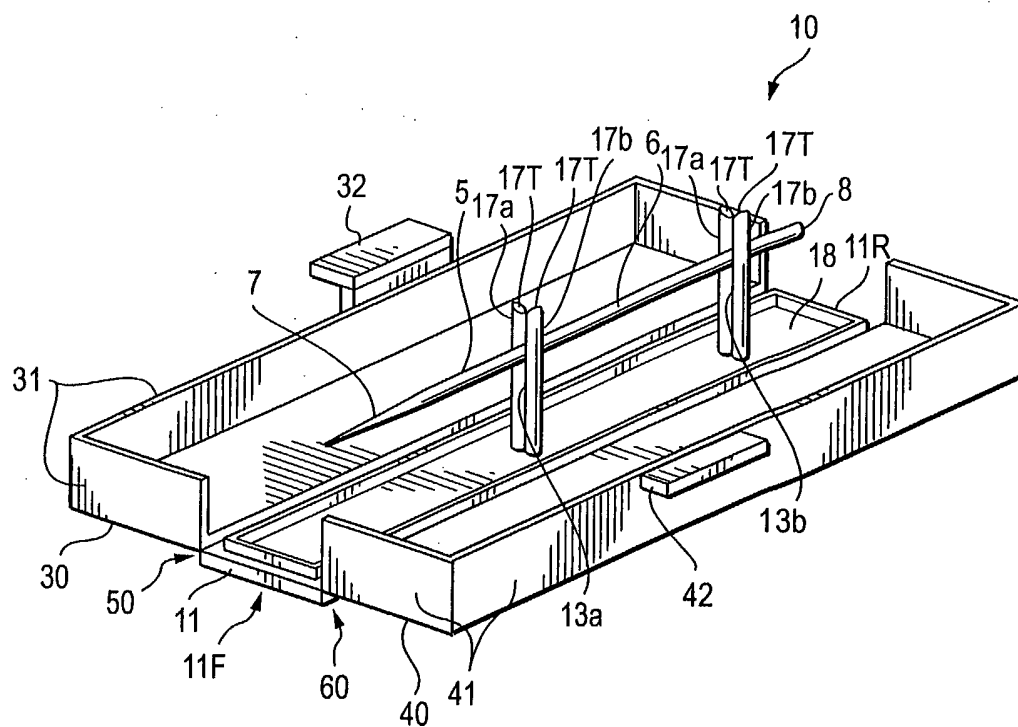


FIG. 1

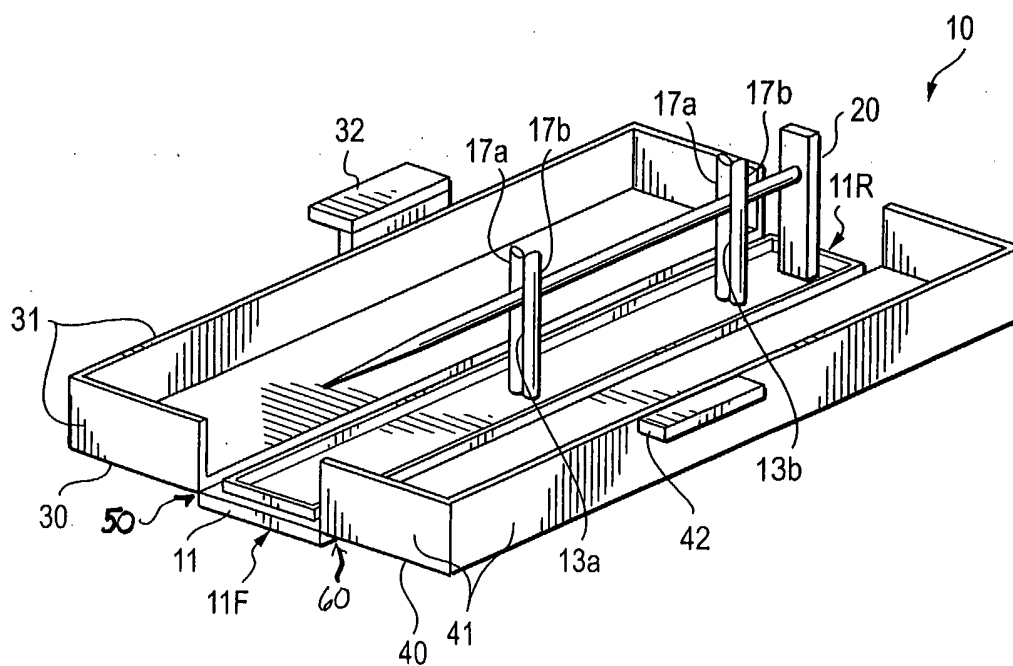


FIG. 2

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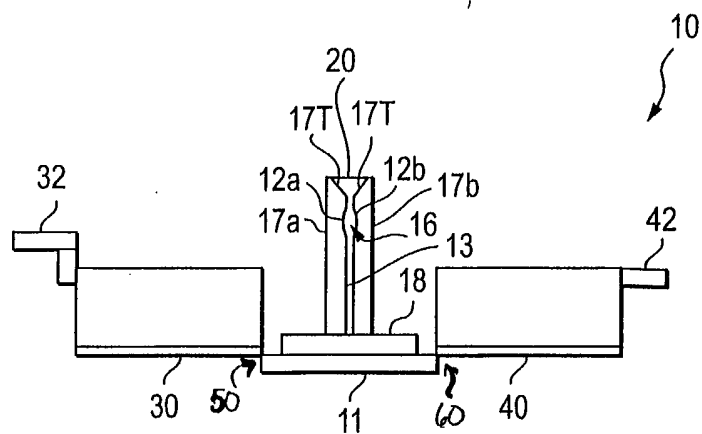


FIG. 3

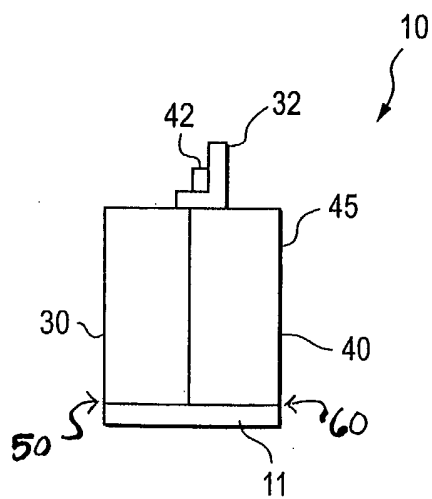


FIG. 4

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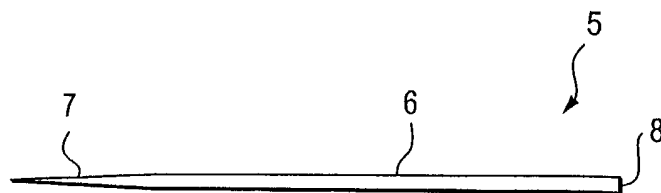


FIG. 5

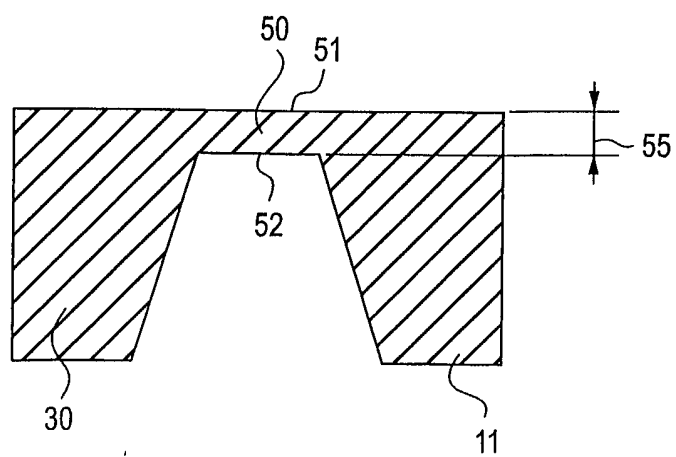


FIG. 6

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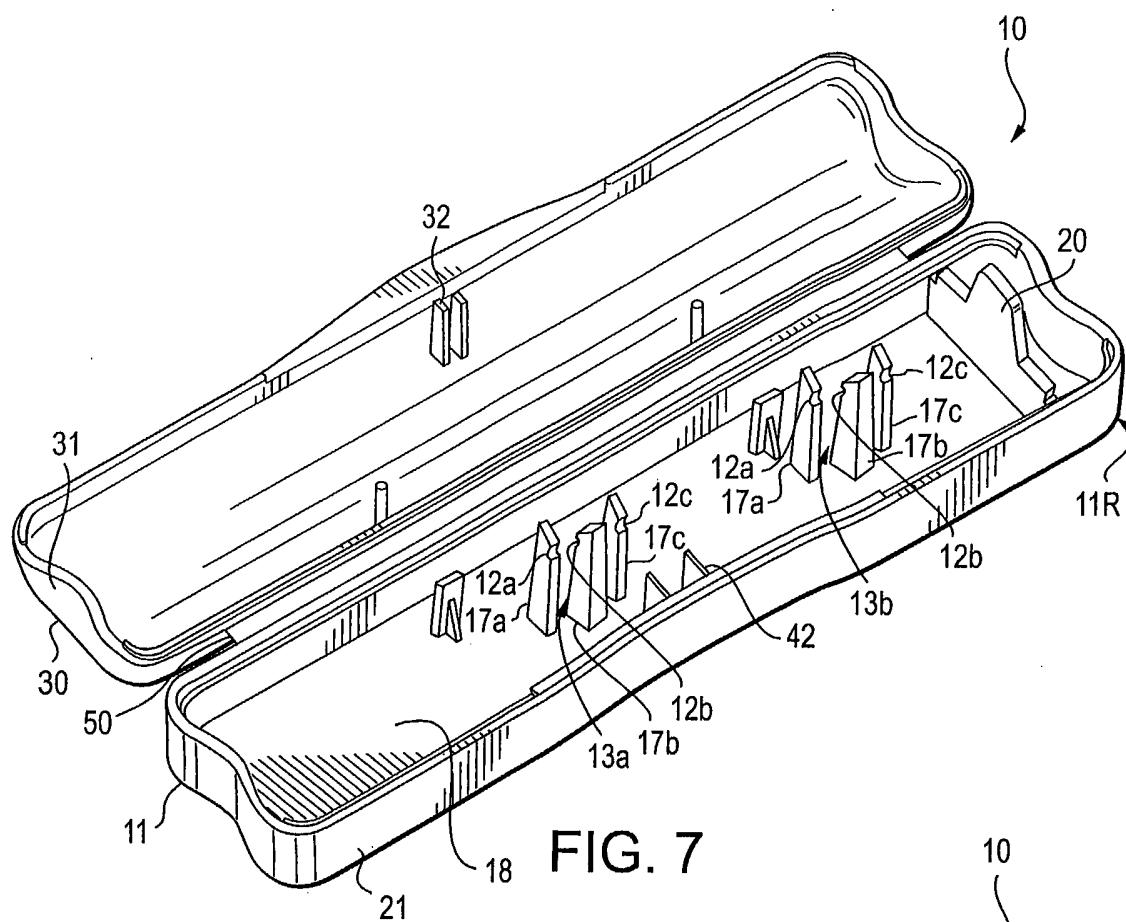


FIG. 7

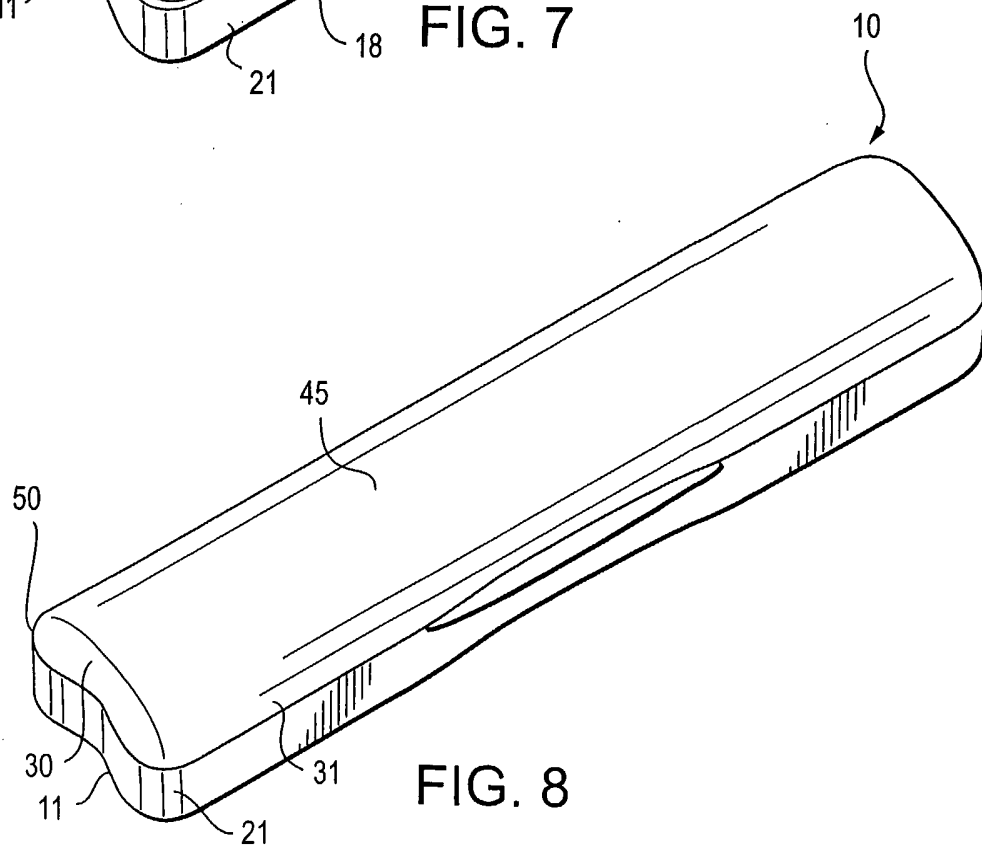


FIG. 8

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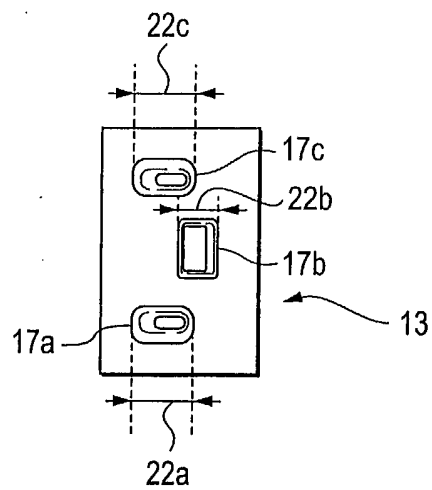


FIG. 9A

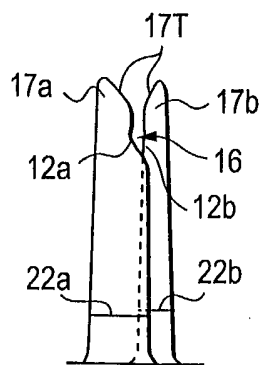


FIG. 9B

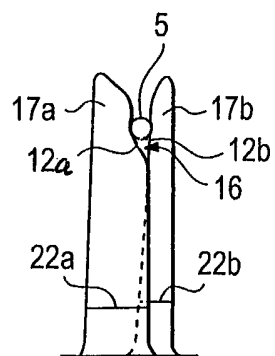


FIG. 9C

## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US2005/026350

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B01L9/00 B65D81/02

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)

IPC 7 B01L B65D

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 practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                                                                        | Relevant to claim No. |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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Date of the actual completion of the international search

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Tragoustis, M

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Information on patent family members

International Application No

PCT/US2005/026350

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