

SOMATOSENSORY TERMINAL FEEDBACK CANE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/654,449, filed June 1, 2012, which is incorporated by reference herein in its entirety.

BACKGROUND

[0002] In 2010, the WHO estimated that there were 285 million globally with visual impairment, 39 million of who were “blind” and 246 million who had “low vision.” A traditional white cane is a common tool used by blind or low vision people. James Biggs, a photographer blinded following an accident, invented the white cane in 1921; he found it prudent to paint his walking stick white as a symbol of his impairment for the heavy traffic surrounding his domicile. This movement was later fostered by Guilly d’Herbement of France in 1931 for the French veterans of WWI. Individuals and companies have attempted to further the advancement of the white cane or navigating tools. However, at the end of the day prosthetics departments offer amputees complex \$70,000 joint components and our visual occupational therapists offer our legally blind a simple, modified, low profile, white cane tip. Simply observing a visually impaired individual ambulate with a conventional white cane over several minutes on a Manhattan street provides enough encouragement to redefine their assistive device.

SUMMARY

[0003] In general, one aspect of the subject matter described in this specification can be embodied in a cane that includes a handle and a pylon that includes a satellite leg control operably connected to the handle. The cane further includes a terminal feedback device that is operably connected to the pylon. The terminal feedback device includes a plurality of satellite legs and a plurality of suspension systems. Each satellite leg is operably connected to a single suspension system. The terminal feedback device also includes a plurality of wheels on individual axles. Each wheel is operably connected to a single satellite leg.

[0004] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, implementations, and features described above, further aspects, implementations, and features will become apparent by reference to the following drawings and the detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The foregoing and other features of the present disclosure will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only several implementations in accordance with the disclosure and are, therefore, not to be considered limiting of its scope, the disclosure will be described with additional specificity and detail through use of the accompanying drawings.

[0006] Fig. 1A illustrates a somatosensory terminal feedback cane in an open position in accordance with various illustrative implementations.

[0007] Fig. 1B illustrates a somatosensory terminal feedback cane in a closed position in accordance with various illustrative implementations.

[0008] Fig. 2 illustrates cables connecting satellite legs of a somatosensory terminal feedback cane with a pylon in accordance with various illustrative implementations.

[0009] Fig. 3A illustrates a sliding cuff (satellite leg control) of a somatosensory terminal feedback cane in an open position in accordance with various illustrative implementations.

[0010] Fig. 3B illustrates a sliding cuff (satellite leg control) of a somatosensory terminal feedback cane in a closed position in accordance with various illustrative implementations.

[0011] Fig. 4 illustrates a spring suspension system of a satellite leg in accordance with various illustrative implementations.

[0012] Fig. 5 illustrates a wheel of a somatosensory terminal feedback cane in accordance with various illustrative implementations.

[0013] Fig. 6A-6F illustrate a somatosensory terminal feedback cane in accordance with various illustrative implementations.

[0014] Fig. 7A-7B illustrate a comparison between a standard cane and a somatosensory terminal feedback cane in accordance with various illustrative implementations.

[0015] Fig. 8A-8H illustrate a two-wheel somatosensory terminal feedback cane in accordance with various illustrative implementations.

[0016] Fig. 9A-9B illustrate a somatosensory terminal feedback cane with a retracting shaft in accordance with various illustrative implementations.

[0017] Figs. 10A-10B illustrate a wheel of a somatosensory terminal feedback cane in accordance with various illustrative implementations.

[0018] Reference is made to the accompanying drawings throughout the following detailed description. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative implementations described in the detailed description, drawings, and claims are not meant to be limiting. Other implementations may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, and designed in a wide variety of different configurations, all of which are explicitly contemplated and made part of this disclosure.

DETAILED DESCRIPTION

[0019] The current disclosure describes a somatosensory terminal feedback cane that alters the conventional white cane and rehabilitation principles in navigation

assistance. The somatosensory terminal feedback cane described in detail below can provide a more consistent, reliable, versatile, and enhanced tactile feedback to the visually impaired during ambulation. Implementations of the present invention include a somatosensory enhancing tool that provides increased feedback for the visually challenged to enhance travel. This allows for more consistent and more reliable environmental information within an adequate time window to allow response and redirection by the user.

[0020] Figure 1A illustrates a somatosensory terminal feedback cane 100 in an open position in accordance with various illustrative implementations. The somatosensory terminal feedback cane 100 can include three components: a handle/control system 102, a pylon 104, and a terminal feedback device 106. In one implementation, the terminal feedback device 106 can be a hexagonal base with six wheels 108. The wheels 108 can be small, satellite, uni-axle wheels 108 on independent suspension systems. In other implementations, a different number of wheels can be utilized. For example, the number of wheels can be, but is not limited to, 2, 3, 4, 7, 8, 10, etc. The six axles can be connected to the pylon 104 by six satellite legs 110 affixed to the pylon 104 with vertical displacement joints. The pylon 104 may be fitted with a small conventional white cane tip (not shown) several inches below the distal end of the pylon 106, a feature of the device that will be implemented when the satellite legs are retracted or flexed and closed. This will allow navigation in a crowded area or the interior of an edifice as opposed to street navigation.

[0021] Figure 2 illustrates cables connecting satellite legs of a somatosensory terminal feedback cane with a pylon in accordance with various illustrative implementations. Each cable 202 can be connected to a single satellite leg 110. The cable 202 can attach to either the distal portion or a midportion of the satellite leg 110. The cables 202 in conjunction with the vertical joints allow the satellite legs 110 and suspension systems to be withdrawn with a harness/cable set-up deployed at the proximal end of the pylon 106. In one implementation, a sliding cuff 302 can be affixed to the proximal end of the cables 202. The sliding cuff 302 can move over a portion of the pylon 104. As the sliding cuff 302 moves, the cables 202 attached to the satellite

legs 110 can pull or release the satellite legs 110 to move the somatosensory terminal feedback cane into a closed or open position. In one implementation, each satellite leg 110 can be attached to the pylon 104 via a hinge. As the sliding cuff 302 moves, the satellite legs 110 can move based upon the hinge. Figure 3A illustrates a sliding cuff 302 of a somatosensory terminal feedback cane in an open position in accordance with various illustrative implementations. In one implementation, the satellite legs descend 110 degrees from the pylon 104 in the open position. Other degrees of descent can also be use, such as, but not limited to, 60, 90, 120, 145, etc. Figure 3B illustrates a sliding cuff of a somatosensory terminal feedback cane in a closed position in accordance with various illustrative implementations. In Figure 3B, the sliding cuff 302 has moved into an up or satellite leg flexed position. In one implementation, the sliding cuff 302 can lock into various positions at degree intervals. For example, from the closed position, the sliding cuff 302 can lock into position when the satellite legs 110 have been lowered 60 degrees. Continuing to push on the sliding cuff 302 can allow the satellite legs to open to another locked position, e.g., 120 degrees. Different degree intervals and non-consecutive intervals can be used for locking the cane into different positions. As another example, from the closed position, a cane can first lock at 110 degrees and have a second locking position at 120 degrees.

[0022] A somatosensory terminal feedback cane can provide improved tactile feedback to the visually impaired as they ambulate in an outdoor and indoor environment. The traditional white cane is implemented by the user in a sweeping movement, covering the territory the subject may need to progress forward in his or her immediate space. This offers inconsistent feedback depending on the fashion in which the subject swings the white cane in relationship to how he or she advances forward. For example, a user that steps forward with a right leg while swinging left to right can have different feedback compared to a user that swings right to left or steps forward with a left leg. In addition, the traditional white cane can itself become a hindrance. For example, a visually impaired subject can swing the traditional white cane around an approaching obstacle and then stumble based upon the cane's contact with the

approaching obstacle, e.g., the scaffolding that the white cane gets hung up on during the “swing” phase.

[0023] Navigating with a somatosensory terminal feedback cane will involve a key difference compared to navigation with a traditional white cane: a static position with regard to lateral movement of the cane. The somatosensory terminal feedback cane can be placed approximately three feet in front of the subject and wheeled forward as the subject receives tactile feedback from each individual wheel as it elevates, depresses, increases or decreases in speed (perhaps indicating a floor material change, e.g., hardwood versus carpet), is stymied by an approaching obstacle, etc. In one implementation, the diameter of the somatosensory terminal feedback cane can be approximately the width of the individual. There is no need to swing the cane. Further, the user does not have to move his or her arm to sweep the cane across their path. This can lead to reduced confusion between limb advancement and device advancement. In the illustrated implementation of Figure 1A, the six independently suspended wheels 108 can create ease of progression in space and also provide enhanced feedback to the user over a larger three-dimensional space footprint. This can significantly improve ambulation outdoors. In some implementations, the somatosensory terminal feedback cane can be converted into a traditional white cane. For example, in a crowded environment, based on a simple cable system, the six spokes of the terminal feedback cane retract to reveal a simple cane tip to be used in tighter spaces.

[0024] In some implementations, each satellite leg 110 can contain a suspension system. For example, the suspension system can be a spring suspension system. Each satellite leg 110 can have its own suspension system such that each suspension system is an independent suspension system. In one implementation, the suspension system can be placed between the satellite leg and the wheel. In another implementation, the suspension system can be attached to a distal portion of the satellite leg that bears the axle of the respective wheel. Figure 4 illustrates a spring suspension system of a satellite leg in accordance with various illustrative implementations. A spring 402 accommodates the satellite leg 110 to imperfections

and minor obstacles on the immediate ground. The satellite leg 110 can be connected to a wheel 108. Figure 5 illustrates a wheel 108 of a somatosensory terminal feedback cane in accordance with various illustrative implementations. As an example of using a somatosensory terminal feedback cane, the cane can be placed approximately three feet ahead of the subject as he or she ambulates. As the cane moves over imperfections and obstacles, the imperfections and obstacles will be translated from the wheel to the satellite leg to the pylon and to the handle in the hand of the subject navigating himself or herself forward. For example, as a leftmost wheel on its individual axle dips into a small area of depressed and uneven cement on an old sidewalk, the subject will feel the cane slightly dip into that recess and adjust accordingly, perhaps slightly altering his or her path toward the right.

[0025] As described above, a somatosensory terminal feedback cane can be in either an open or closed position. In one implementation, a user can maneuver a sliding cuff 302 to open and close the cane. In the closed position, the cane 100 can operate in a similar fashion as a traditional white cane. Figure 1B illustrates the somatosensory terminal feedback cane 100 in a closed position in accordance with various illustrative implementations. In the closed position, the cane 100 can be used to navigate in a crowded area. In one implementation, to further enhance the cane 100 in the closed position, the pylon 104 may be fitted with a small conventional white cane tip several inches below the distal end of the pylon 106. The white cane tip can then be used as a traditional white cane when the satellite legs are retracted or flexed and closed.

[0026] The proximal portion of the pylon 106 may be attached to the handle/control system 104. The handle/control system 104 can be fit with a neoprene handle for comfort and for providing feedback from the six wheels 108. The handle/control system 102, the pylon 104, and the terminal feedback device 106 can be made of material such as, but not limited to, carbon fiber, aluminum, plastics, etc. In one implementation, the handle/control system 102 and/or the pylon 104 can include a recess that can receive an extension. For example, the extension can be another cane, an extension which increases the height of the cane, etc. The handle/control

system 102 can also include a wrist loop. The wrist loop can keep the cane within reach of a subject, even if the subject loses his or hers grip on the cane.

[0027] Figures 6A-6F illustrate a somatosensory terminal feedback cane in an open position in accordance with various illustrative implementations. Figures 6A and 6B illustrate the somatosensory terminal feedback cane in an open and closed position, respectively. In the illustrated implementation, the somatosensory terminal feedback cane includes four satellite legs 602, as illustrated in Figures 6C. The four satellite legs 602 increase the ground coverage compared to a traditional white cane and also enhances balance. In addition, the four satellite legs 602 can be used such that the swinging of the somatosensory terminal feedback cane is not required. The four satellite legs 602 can have staggered lengths, as shown in Figure 9D. For example, each leg can have a different length, pairs of legs can have different lengths, etc. The different lengths can improve edge detection. In another implementation, the somatosensory terminal feedback cane can have webbing between the satellite legs as shown in Figure 6E. The webbing can shield a user from small obstacles and can increase the durability and/or stability of the four satellite legs. As described above, the somatosensory feedback terminal cane can be retractable, as shown in Figures 6B and 6F. When retracted the somatosensory feedback terminal cane is portable and can also be used as a conventional cane.

[0028] Figures 7A-7B illustrate a comparison between a standard cane and a somatosensory terminal feedback cane in accordance with various illustrative implementations. In Figure 7A, the user is shown using a conventional white cane. If the white cane is not properly swung hazards can be missed. Figure 7B illustrates the use of a somatosensory terminal feedback cane. As shown in Figure 7B, the user is not required to swing the somatosensory terminal feedback cane back and forth as they walk while still identifying hazards.

[0029] As described above, a somatosensory terminal feedback cane can have a plurality of wheels. In one implementation, a somatosensory terminal feedback cane has two wheels. Figures 8A-8H illustrate a two-wheel somatosensory terminal

feedback cane in accordance with various illustrative implementations. Figure 8A illustrates a schematic of a two-wheel somatosensory terminal feedback cane 800. Figure 8B is a photograph of a prototype of a two-wheel somatosensory terminal feedback cane 800. The cane 800 includes a handle 802 connected to a pylon 806. A sliding retractor handle 808 can move along the axes of the pylon 806 to open and close the cane 800. The sliding retractor handle 808 can be moved to a closed position where the sliding retractor handle 808 can be locked in the closed position via a top lock 804. There is also a corresponding locking position 822 (shown in Figure 8B) that is used to lock the sliding retractor handle 808 into the open position. Two legs 810 and a retracting strut 812 are connected to the sliding retractor handle 808. When moved from the open to the closed position, the sliding retractor handle 808 causes the retracting strut 812 to move along the axes of the pylon 806. In one implementation, the pylon 806 is hollow and a portion of the retracting strut 812 moves into the hollow portion of the pylon 806 when the cane is closed. The legs 810 can move toward the axes of the pylon based upon hinged joints 814, 816, and 818. Each hinged joint can have a hinge or other hinging mechanism. Figures 8C-8H illustrate the open, closing/opening, and closed positions. The cane 800 also includes two wheels 820. As described in greater detail below in regard to Figures 10A-10B, the wheels 820 can also have an open and closed position.

[0030] Figures 9A-9B illustrate a somatosensory terminal feedback cane with a retracting shaft in accordance with various illustrative implementations. Figure 9A is a schematic and Figure 9B is a photograph of a prototype of a somatosensory terminal feedback cane with a retracting shaft. The retracting shaft 920 can join the retractor handle and the central joint.

[0031] Figures 10A-10B illustrate a wheel of a somatosensory terminal feedback cane in accordance with various illustrative implementations. Figure 10A illustrates the wheel when the somatosensory terminal feedback cane is in the open position. Figure 10B illustrates the wheel when the somatosensory terminal feedback cane is in the closed position. In this embodiment, a subretractor system includes multiple hinges 1002a-1002e that are operably connected to the sliding retractor handle. The

subretractor system controls the position of the wheels in the open and closed position of the somatosensory terminal feedback cane. In one implementation, the wheels in the closed position are positioned to maximize utility of the somatosensory terminal feedback cane.

[0032] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular inventions. Certain features described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0033] Similarly, while operations are depicted in the drawings and tables in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated in a single software product or packaged into multiple software products.

[0034] It is to be understood that such depicted architectures are merely exemplary, and that in fact many other architectures can be implemented which achieve the same functionality. In a conceptual sense, any arrangement of components to achieve the same functionality is effectively "associated" such that the desired functionality is

achieved. Hence, any two components herein combined to achieve a particular functionality can be seen as "associated with" each other such that the desired functionality is achieved, irrespective of architectures or intermedial components. Likewise, any two components so associated can also be viewed as being "operably connected", or "operably coupled", to each other to achieve the desired functionality, and any two components capable of being so associated can also be viewed as being "operably couplable" to each other to achieve the desired functionality. Specific examples of operably couplable include but are not limited to physically mateable and/or physically interacting components and/or wirelessly interactable and/or wirelessly interacting components and/or logically interacting and/or logically interactable components.

[0035] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0036] It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or

more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations, or two or more recitations).

Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

[0037] Thus, particular implementations of the invention have been described. Other implementations are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results. In certain implementations, multitasking and parallel processing may be advantageous.

WHAT IS CLAIMED IS:

1. A cane comprising:

a handle;

a pylon comprising satellite leg control operably connected to the handle; and

a terminal feedback device operably connected to the pylon, wherein the terminal feedback device comprises:

a plurality of satellite legs; and

a plurality of wheels on individual axles, wherein each wheel is operably connected to a single satellite leg.

2. The cane of claim 1, wherein the terminal feedback device is configured to move between an open position and a closed position.

3. The cane of claim 2, wherein in the open position the plurality of satellite legs descend 110 degrees to allow peripheral environment detection as the cane is advanced forward in a laterally static fashion hence without swing.

4. The cane of claim 2, wherein the cane further comprises:

a sliding cuff operably connected to the pylon and to the plurality of satellite legs via a simple cable system, wherein the sliding cuff is configured to move the terminal feedback device between the open position and the closed position.

5. The cane of claim 4, wherein the simple cable system is affixed proximally to the sliding cuff which locks into position at 60 degree intervals and distally to the midportion of each of the plurality of satellite legs.

6. The cane of claim 5, wherein the sliding cuff is configured to be maneuvered in an up and flexed satellite leg or closed position and a down and extended satellite leg or open position.

7. The cane of claim 1, wherein the terminal feedback device further comprises a plurality of suspension systems, wherein each satellite leg is operably connected to a single suspension system.
8. The cane of claim 7, wherein the terminal feedback device has a plurality of satellite legs with individual suspension mechanisms.
9. The cane of claim 8, wherein the suspension mechanisms are independent suspension mechanisms.
10. The cane of claim 9, wherein each individual suspension mechanism is attached to a distal portion of the satellite leg that bears the individual axle of the terminal wheel.
11. The cane of claim 1, wherein the cane is operable in a folded or closed position to enable the user to swing the cane to detect obstacles above the ground.
12. The cane of claim 1, wherein there is a recess in the handle or pylon adapted to receive a further cane.
13. The cane of claim 1, wherein the handle of the cane comprises a wrist loop to wrap around the distal arm in case the subject's grip slips and the device is caught by the loop attachment.
14. The cane of claim 1, wherein the satellite legs of the terminal device comprise vertical displacement joints within the distal aspect of the pylon to allow the open and closed or flexed and extended position of the cane.

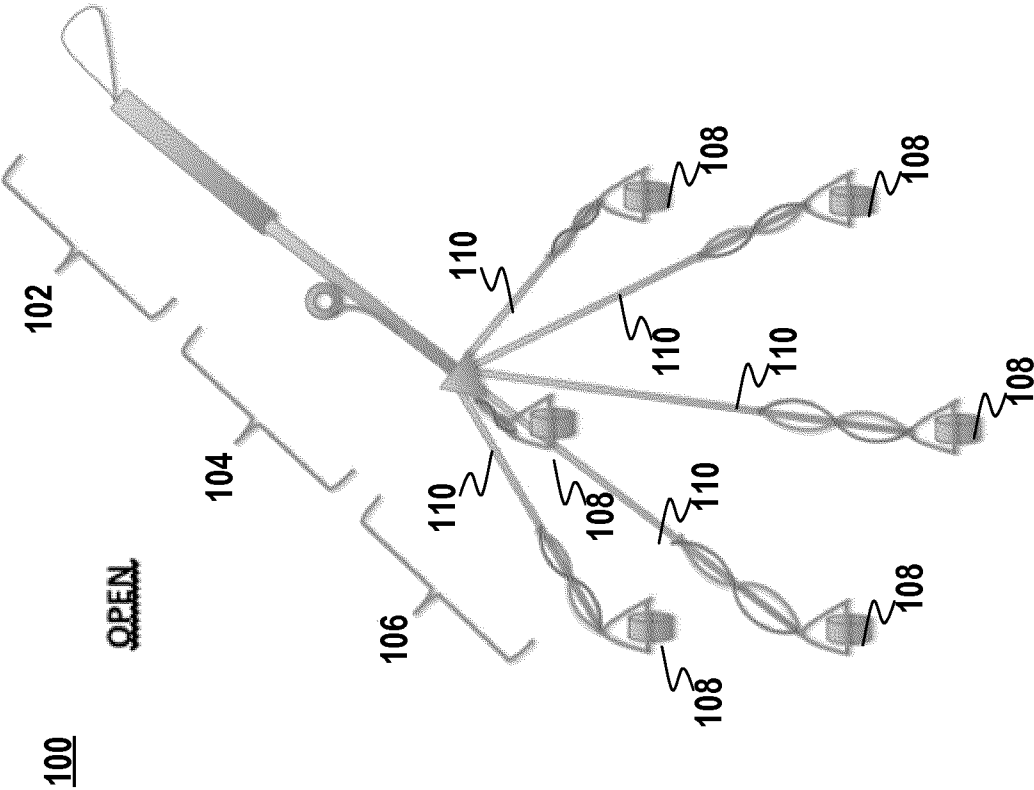


Fig. 1A

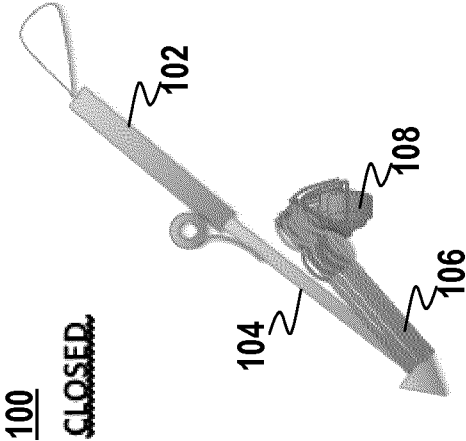
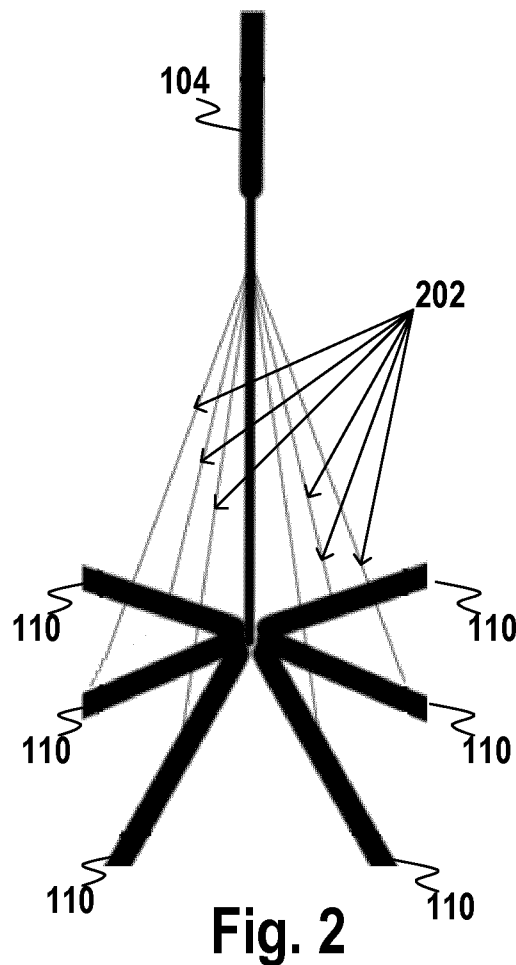


Fig. 1B



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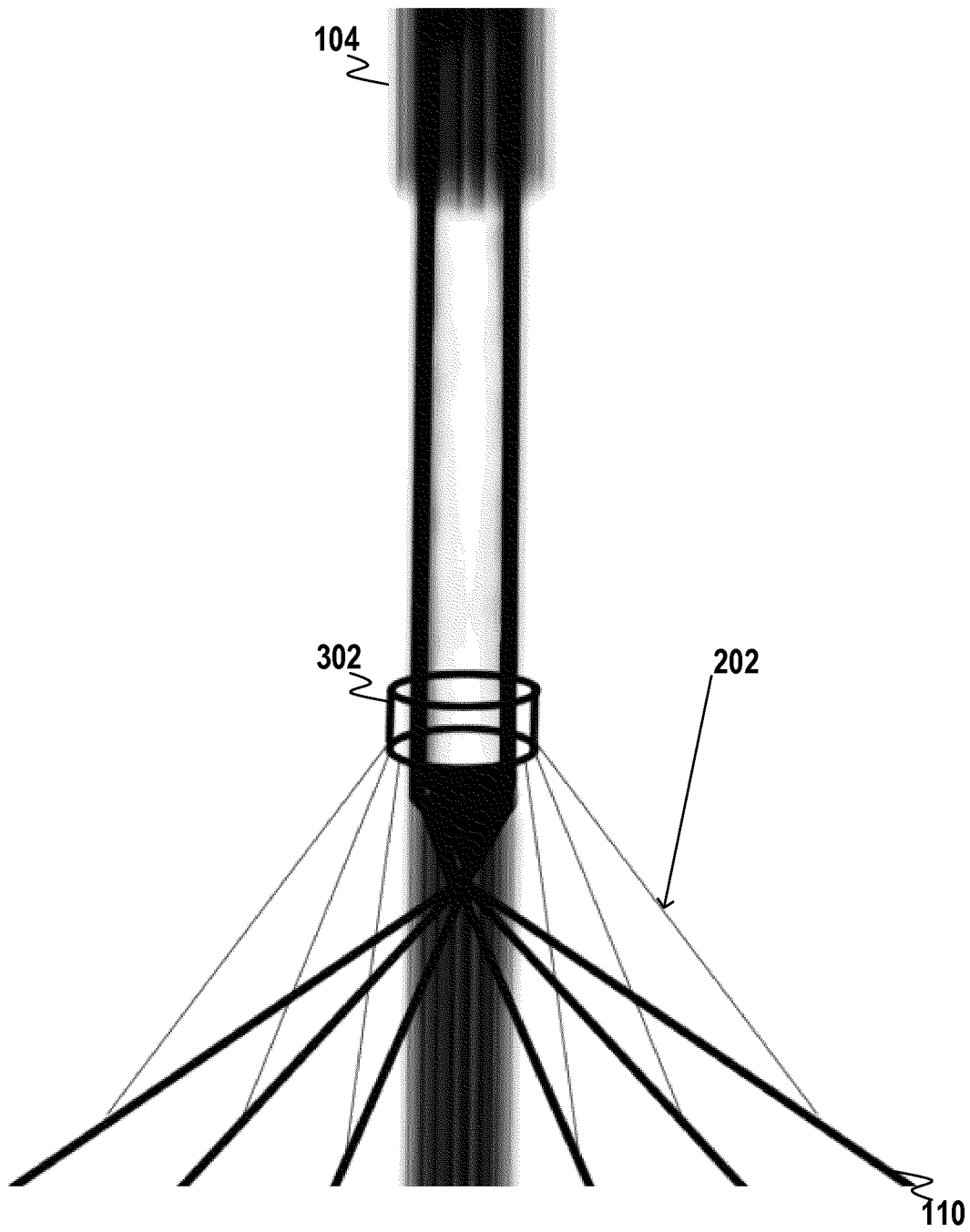


Fig. 3A

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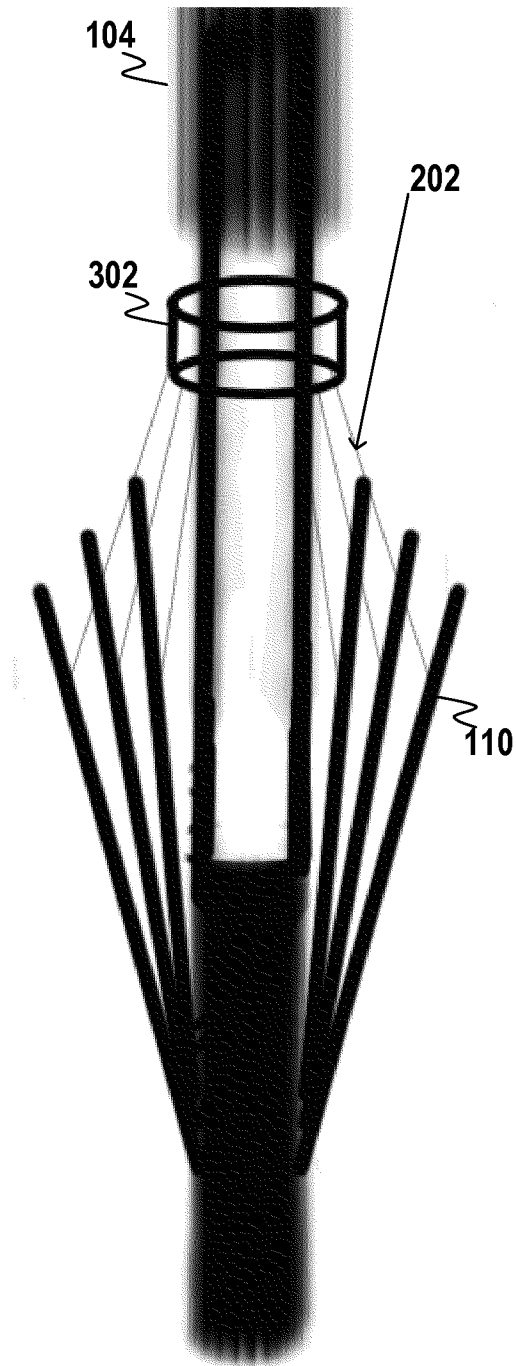


Fig. 3B

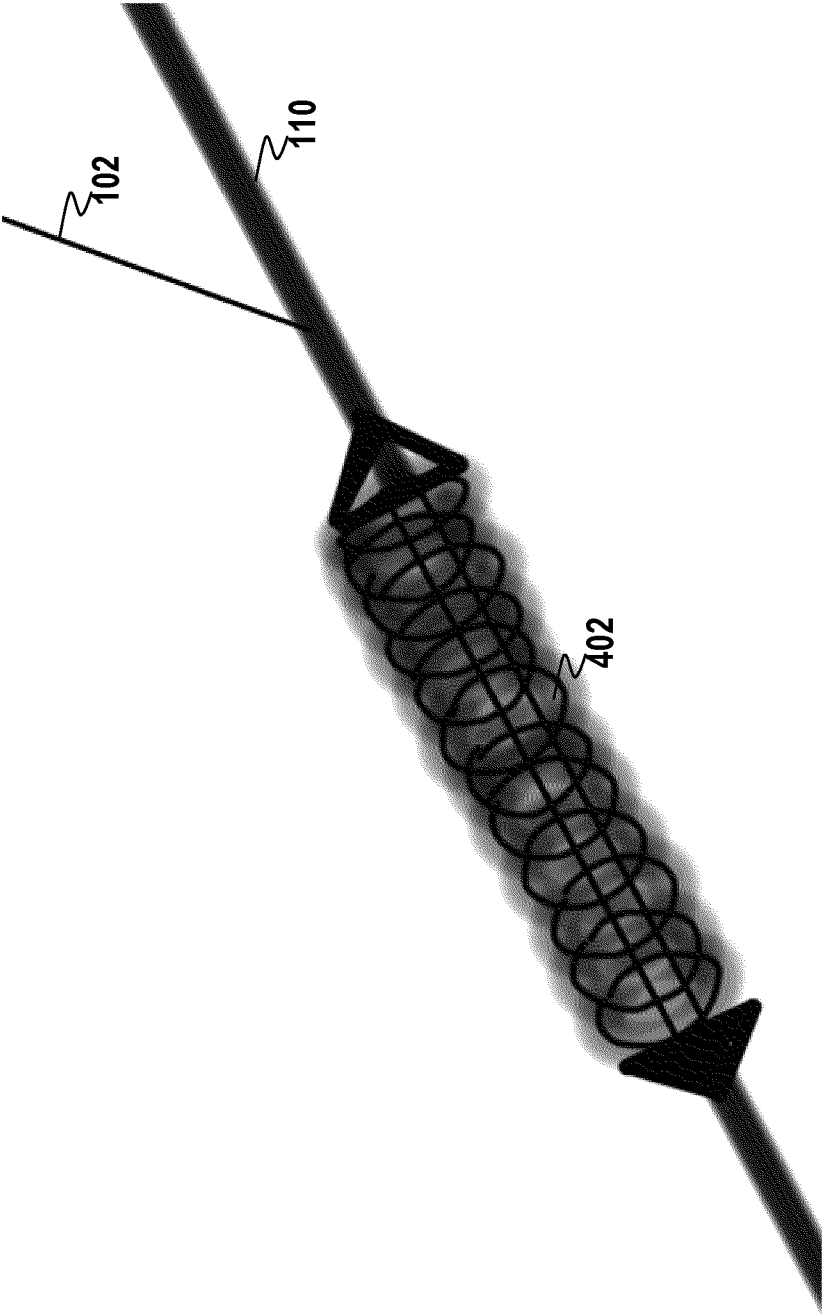


Fig. 4

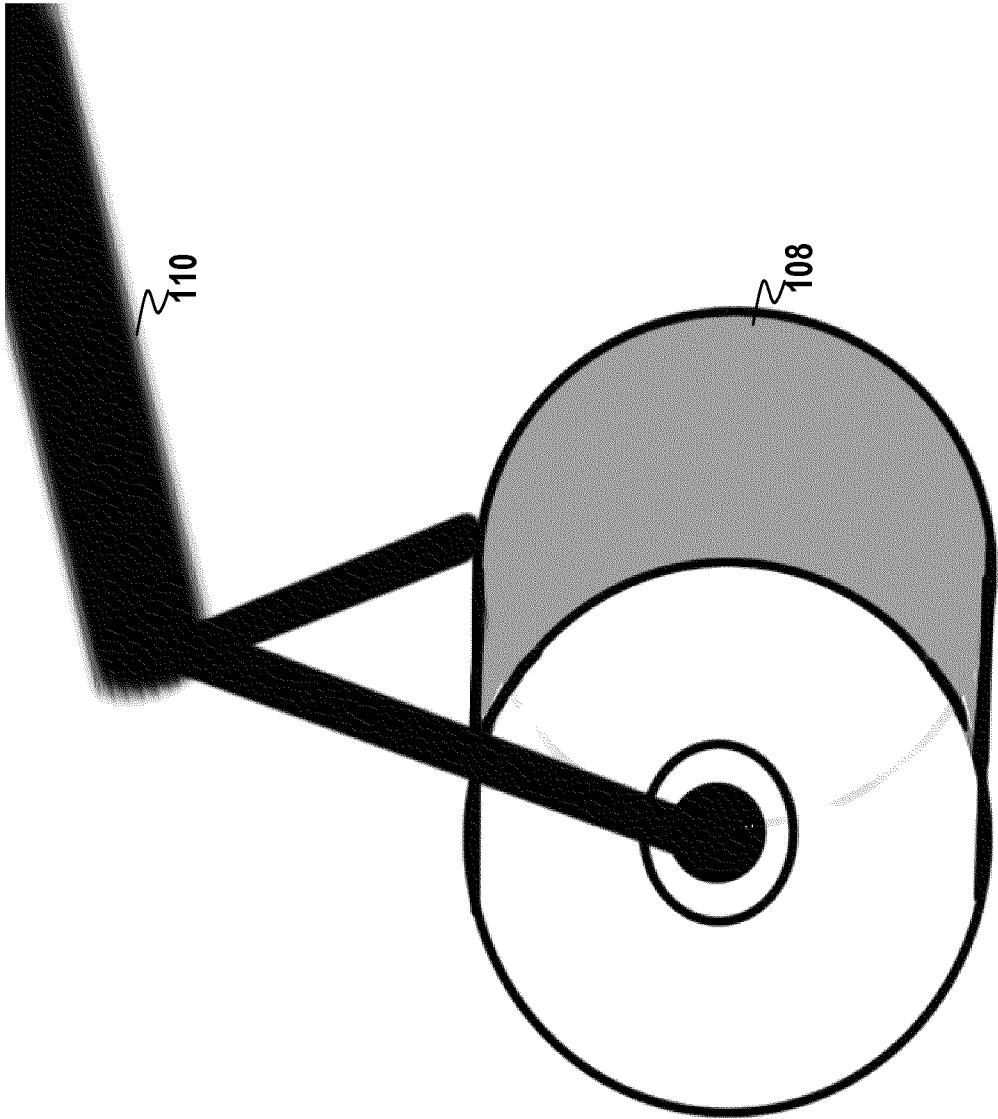


Fig. 5

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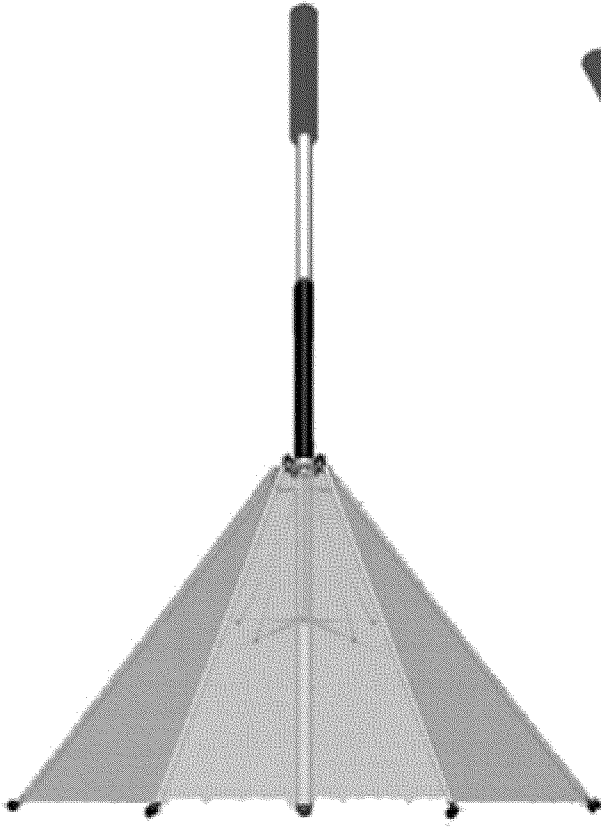


Fig. 6A



Fig. 6B

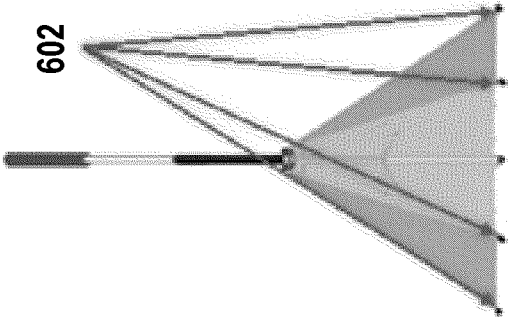


Fig. 6C

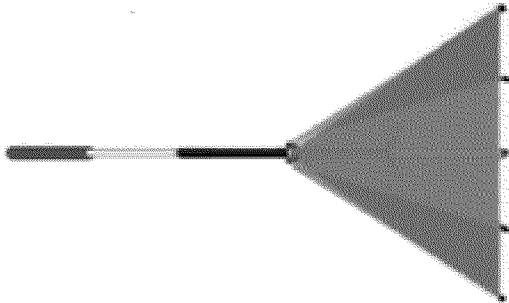


Fig. 6E

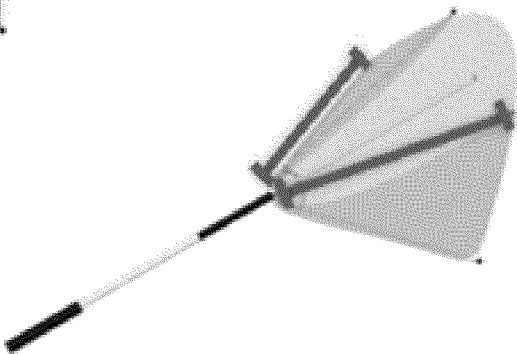


Fig. 6D

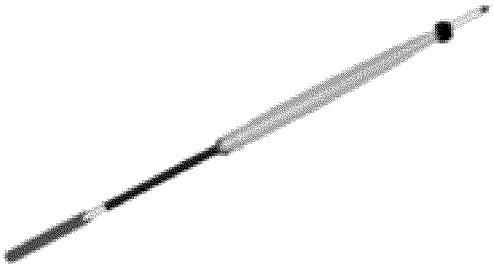


Fig. 6F



Fig. 7B

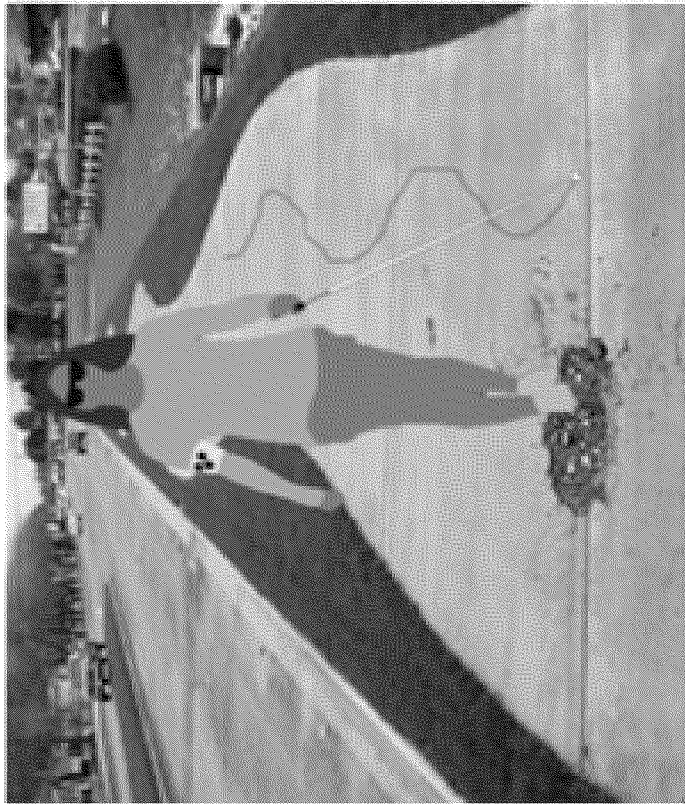


Fig. 7A

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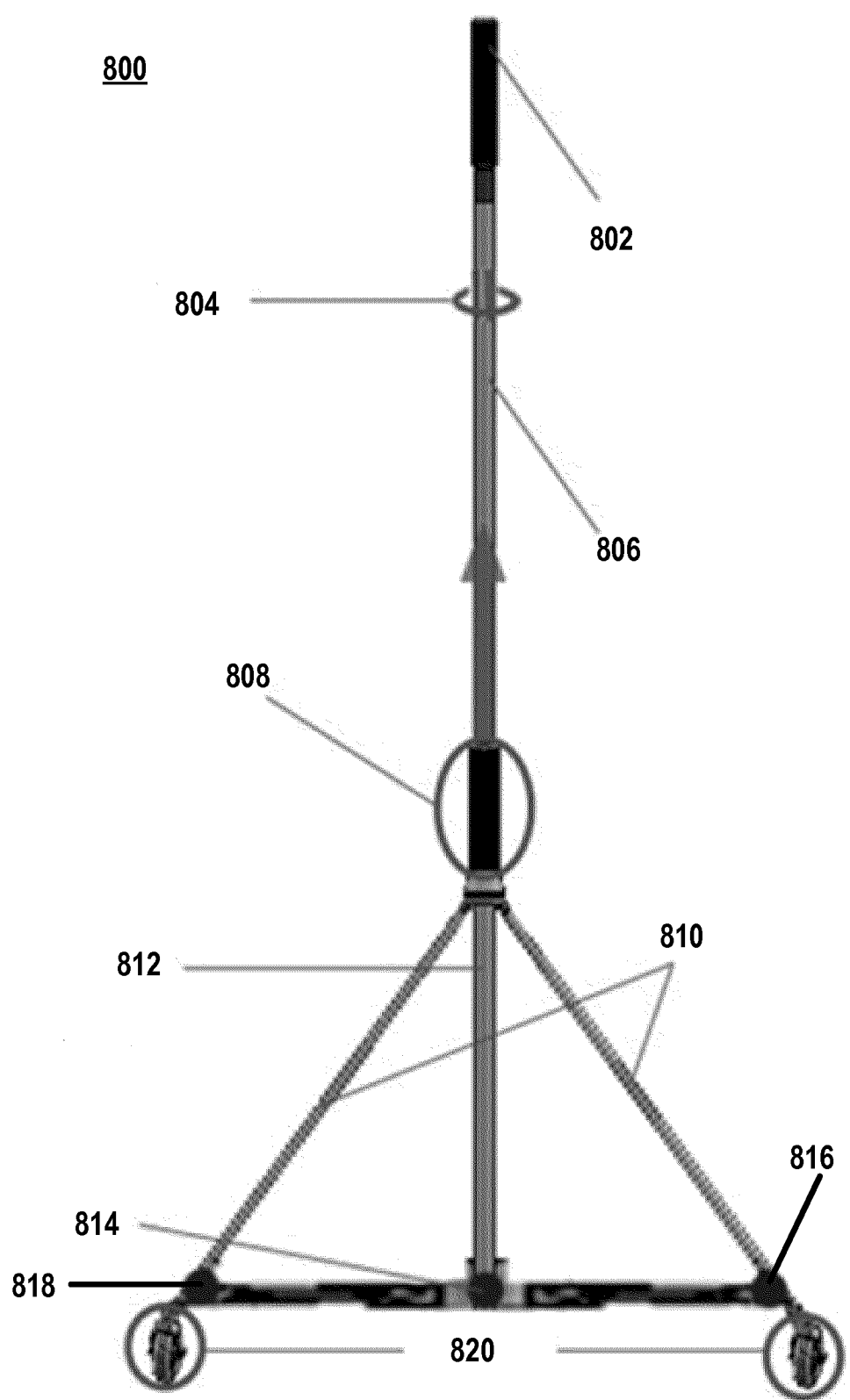


Fig. 8A

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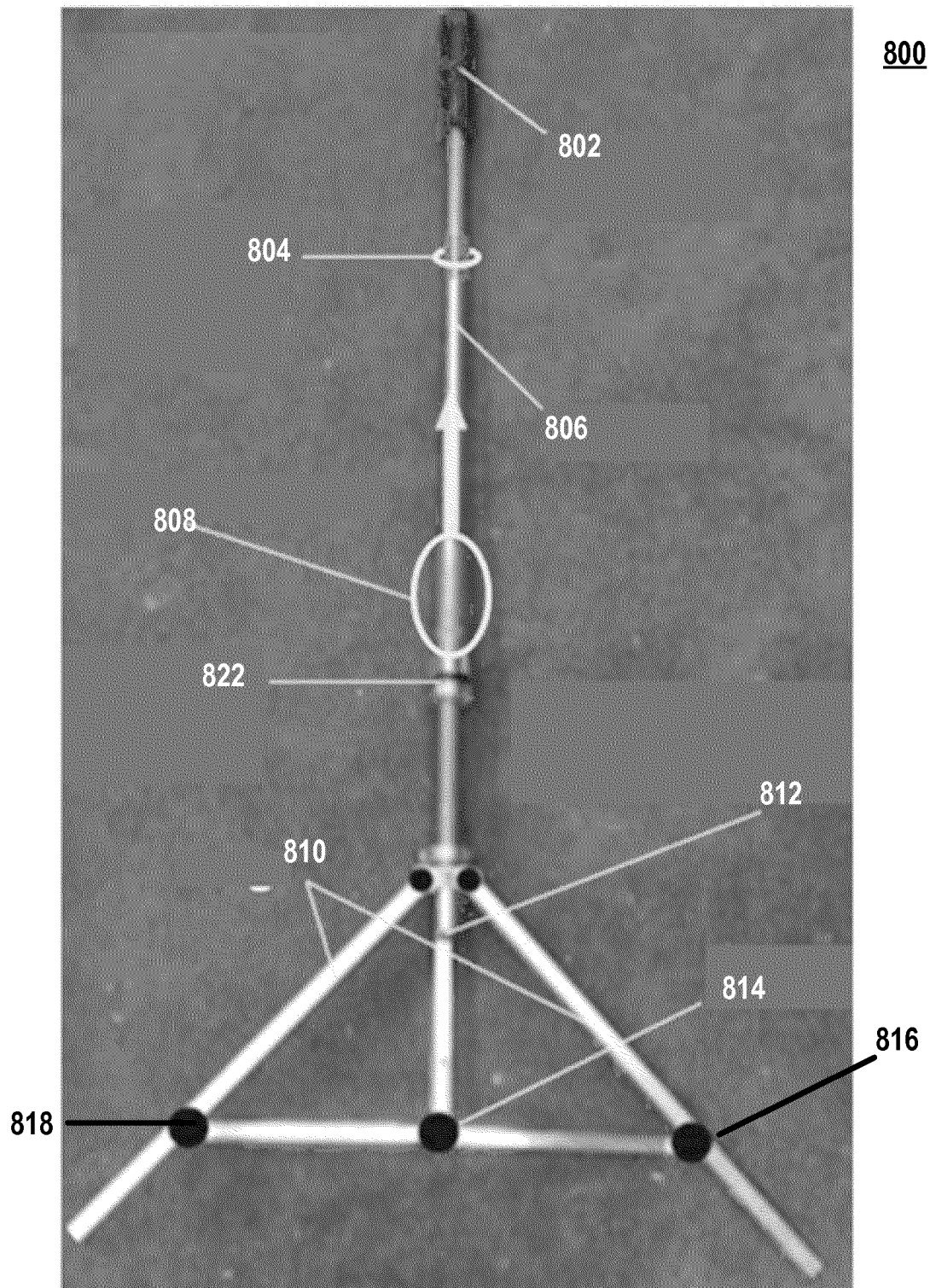
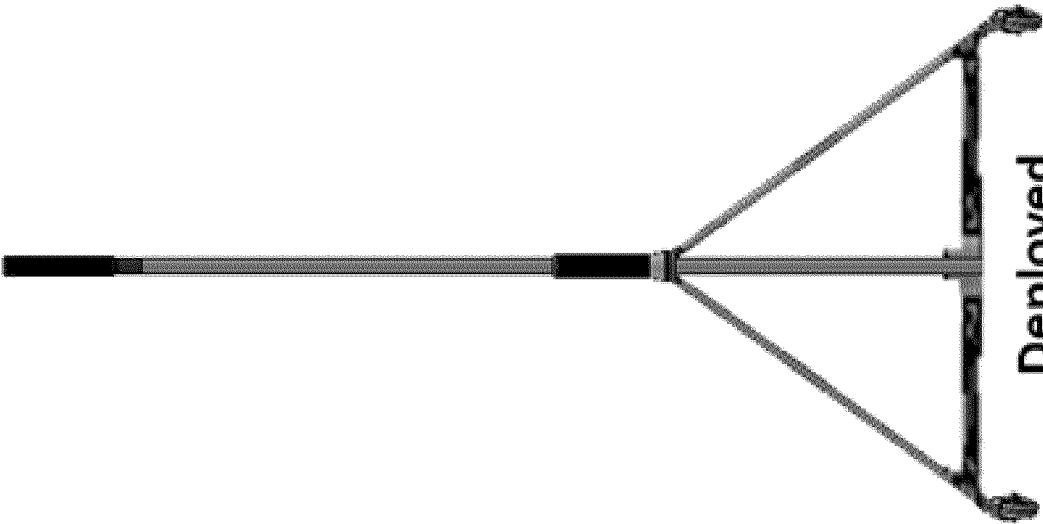
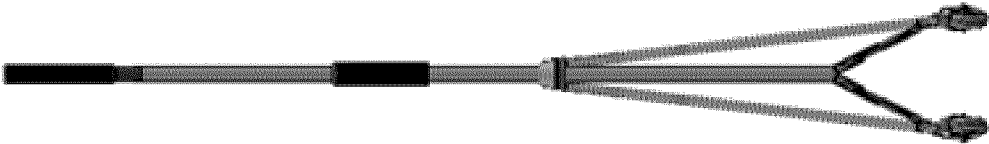


Fig. 8B



Deployed
(Open)

Fig. 8C



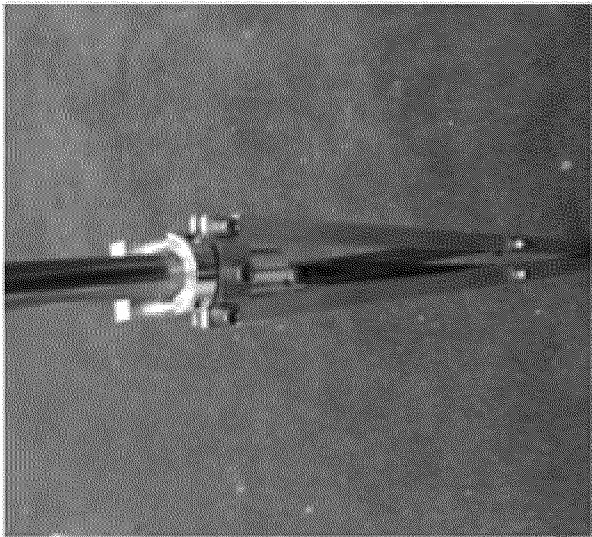
Retracting..
(Closing)

Fig. 8D



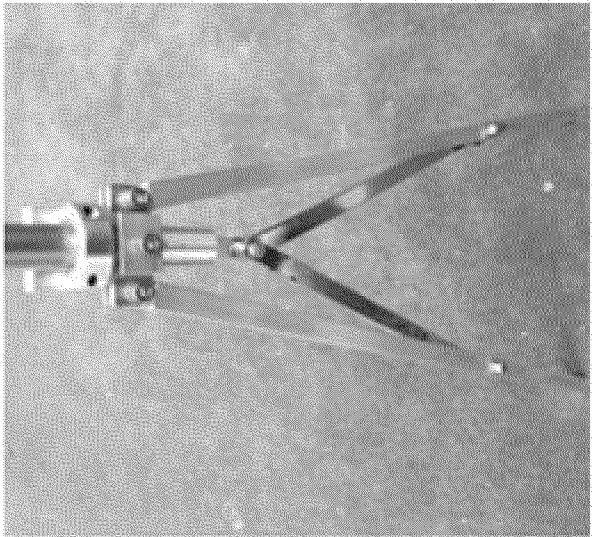
Retracted
(Closed)

Fig. 8E



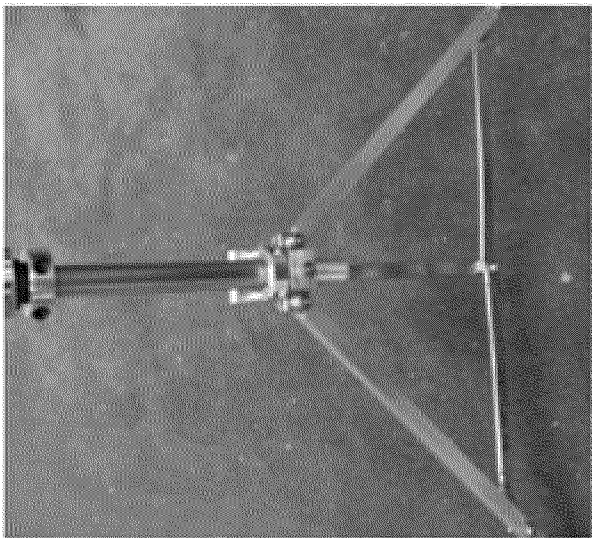
**Retracted
(Closed)**

Fig. 8H



**Retracting..
(Closing)**

Fig. 8G



**Deployed
(Open)**

Fig. 8F

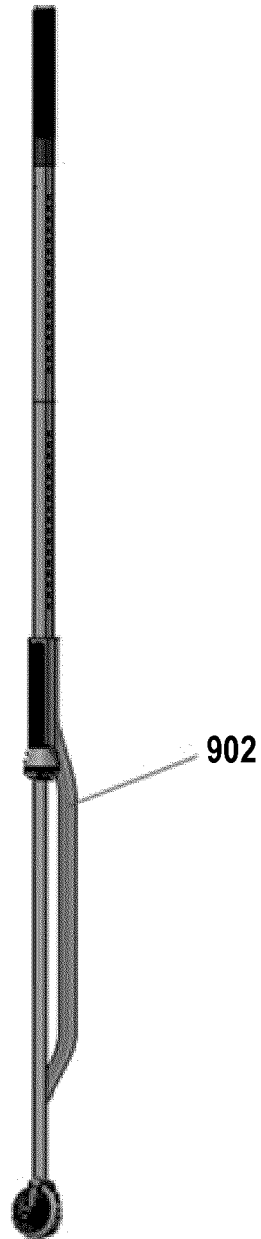


Fig. 9A

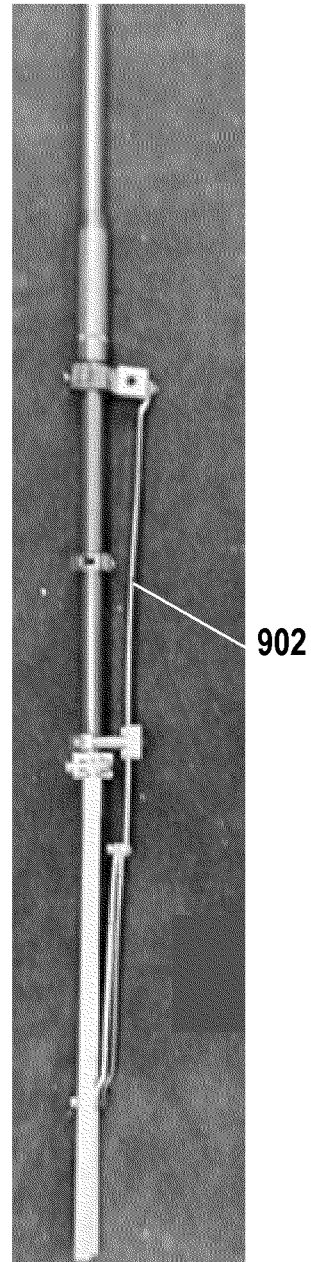
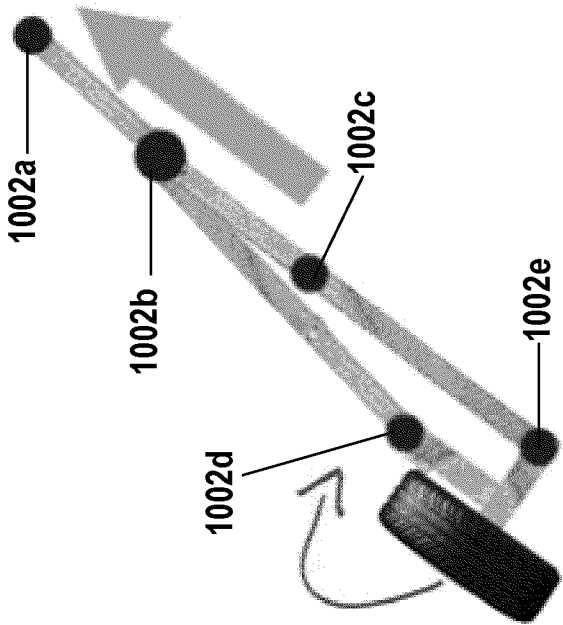
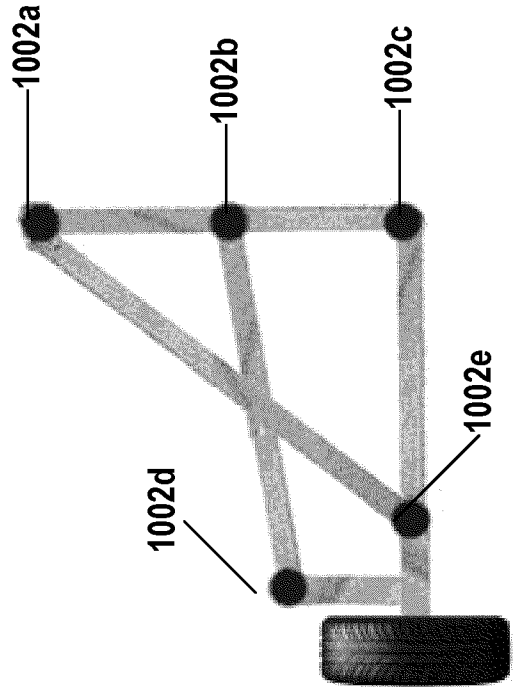


Fig. 9B



**Retracted
(Closed)**
Fig. 10B



**Deployed
(Open)**
Fig. 10A

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2013/043919

A. CLASSIFICATION OF SUBJECT MATTER

A61H 3/06 (2006.01)

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)

A61H 3/00, 3/04, 3/06, A45B 3/00, 3/04, 7/00, 9/00

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)

PatSearch (RUPTO internal), Esp@cenet, PAJ, USPTO, Information Retrieval System of FIPS (<http://www.fips.ru>)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4559962 A (JOHN MARCHIANO) 24.12.1985, abstract, col. 2 line 39-col. 3 line 62, fig. 4	1, 7-10
Y		2-6, 11-14
Y	SU 1088699 A (ISCHENKO V.B. et al.) 30.04.1984, col. 3 lines 20-25, fig. 2	2-6
Y	RU 2184518 C2 (LEVADNY VLADIMIR STEPANOVICH) 10.07.2002, fig. 2	11
Y	RU 2352317 C1 (ZARENKOV VYACHESLAV ADAMOVICH et al.) 20.04.2009, abstract	12
Y	RU 18475 U1 (DRACHKOV RUDOLF NIKOLAEVICH) 27.06.2001, p. 3 lines 18-21, fig. 1, 2	13
Y	RU 115171 U1 (MALININ LEONID PETROVICH) 27.04.2012, p. 2 lines 41-44, fig. 2, 3	14

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

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Name and mailing address of the ISA/ FIPS
Russia, 123995, Moscow, G-59, GSP-5,
Berezhkovskaya nab., 30-1

Facsimile No. +7 (499) 243-33-37

Authorized officer

A. Khanyukin

Telephone No. 8(499)240-25-91