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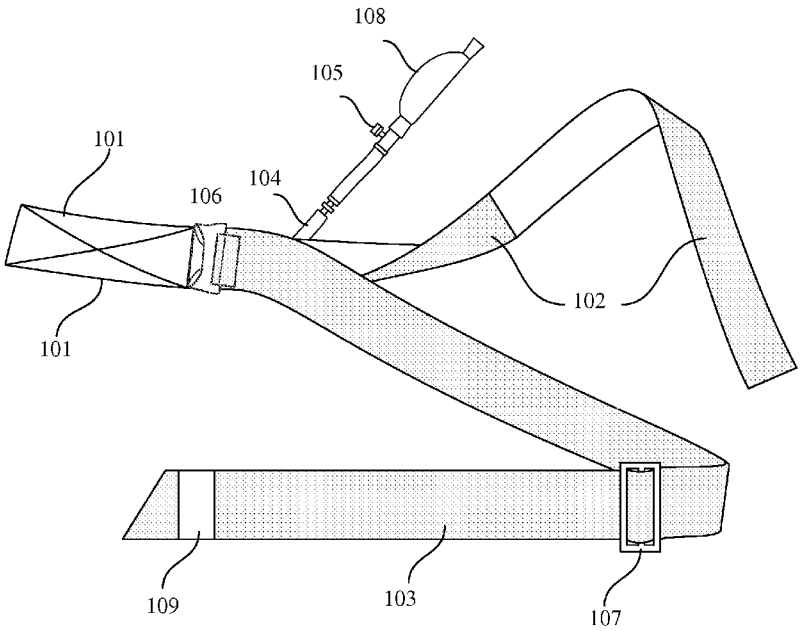


FIG. 1

(57) Abstract: A pre-fabricated pneumatic tourniquet apparatus and related methods are provided. The tourniquet is easy to apply, ensures consistent and even circumferential pressure, is light weight, provides standard life saving operation, and can be utilized in any setting or situation. The pneumatic tourniquet apparatus is comprised of a bladder, a reservoir chassis, a retaining cover, a receiver and a slider. The bladder is elongated in shaped - long enough to wrap around most human limbs.

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A PNEUMATIC TOURNIQUET APPARATUS AND METHOD OF USE

Cross-Reference to Related Applications

This international application claims priority to co-pending U.S. provisional patent application serial no. 61/883,797, filed September 27, 2013, the entire disclosure of which is incorporated herein by reference.

Government Rights

This invention was made with government support under W81XWH-12-P-0497 awarded by USA MED RESEARCH ACQ ACTIVITY. The government has certain rights in the invention.

Field

Embodiments of the present invention are directed to a pneumatic tourniquet and novel blood flow restriction device. In more detail, embodiments of the present invention are directed to an emergency use, pre-fabricated tourniquet used for restricting flow of blood during extreme hemorrhage or exsanguination.

Background

Exsanguination or major blood loss has been shown to be the major leading cause of death on the battlefield and directly correlates to major trauma in the civilian sector. Throughout history, tourniquets have been shown to save lives. Several large studies have confirmed the lifesaving benefit and low incidence of complications from pre-hospital use of tourniquets in combat casualties. Furthermore, the civilian Emergency Medical Services have adopted this opinion as well. Tourniquets are frequently used early in the care of trauma casualties because of the immediate lifesaving intervention capability and the speed with which they can be applied.

Moreover, tourniquets are the standard of care for the temporary control of life-threatening extremity hemorrhage during the Care Under Fire (CUF) phase of the Tactical Combat Casualty Care (TCCC) in accordance with the Committee for Tactical Combat Casualty Care (CoTCCC) guidelines. These guidelines are becoming the standard of care for treatment of massive hemorrhage across the spectrum of pre-hospital care worldwide.

Due to the nature of traumatic amputation and dismemberment, there is a requirement for application of an emergency tourniquet to be operated by one hand. For a device to be truly operable by only one hand, it must be capable of being placed on an extremity, upper or lower, without having to perform fine motor skill functions. In general, tourniquet operation should not require the use of fine motor skills, regardless of the one-handed operability requirement, because tourniquets are generally only used during periods of extreme duress (i.e., when it is difficult or impossible to expect the use of fine motor skills).

Traditionally, tourniquets were nothing more than a general section of cloth material, usually a cravat, and a stick or dowel used as a windless. The general concept was to tighten the cloth material, reducing the circumference (diameter) of the cloth material against the extremity soft tissue, creating circumferential pressure sufficient enough to occlude blood flow. These make-shift tourniquets were often applied with too much pressure and caused neurovascular damage in limbs. Although the patient's life and limb were saved, the affected limb was permanently damaged. Therefore, a pre-fabricated tourniquet designed for consistent, even circumferential pressure is ideal for emergency use.

Additionally, current tourniquet designs are prone to failure and are generally ineffective for use on lower extremities. Pneumatic tourniquet designs can be more desirable than a

windless, mechanical design because pneumatic tourniquets can be more effective at restricting blood flow and can be more comfortable during use. However, because of design and cost constraints, current pneumatic tourniquets are generally only used in Hospital environments and are not effective or mechanically operable for field use.

Furthermore, there are many situations in which a tourniquet can save a life other than in military applications. Some recreational activities can be inherently dangerous and can cause severe injury requiring the use of such an emergency device, especially in a remote setting. Primary examples of this are camping, rock climbing, hiking, boating, etc. Footprint size and weight are always a consideration in such settings since the individual user is required to carry the device in a backpack. Therefore, a ruggedized pre-fabricated tourniquet made of the strong and light material would be best-suited for the end-user. Such a tourniquet would provide for efficient transportation and effective, life-saving utilization.

Thus, there is a need for a pre-fabricated tourniquet that is easy to apply, that ensures consistent and even circumferential pressure, that is light weight, that provides standard life saving operation, and that can be utilized in any setting or situation.

Summary

One object of the general inventive concept is to provide a pneumatically constricting tourniquet apparatus. The pneumatic tourniquet apparatus is made up of a bladder, a reservoir chassis, a retaining cover, a receiver and a slider. The bladder is elongated in shaped – long enough to wrap around most human limbs. In some embodiments, the bladder is formed from a single sheet of plastic, folded over along one edge and sealed along the other three edges so that the bladder holds and maintains air pressure while being inflated.

The reservoir chassis holds and protects the bladder. The reservoir chassis includes a main section that envelops the bladder and a reservoir chassis extension section that extends from the main section but does not envelop the bladder. A retaining cover attached to the reservoir chassis where the main section and the chassis extension section connect. The retaining cover covers and protects the reservoir chassis.

A receiver is connected to either the reservoir chassis or the retaining cover, at a location very near to where the retaining cover is attached to the reservoir chassis. A slider is connected to the retaining cover such that the slider can be slid to any point along the retaining cover. The receiver and slider are sized and shaped such that the slider is temporarily locked in position on the retaining cover as a friction buckle when engaged with the receiver.

Another object of the general inventive concept is to provide a pneumatically constricting tourniquet apparatus. The pneumatic tourniquet apparatus is made up of a bladder placed into a reservoir chassis, a retaining cover attached to the reservoir chassis, a receiver attached to the retaining cover or the reservoir chassis, and a slider attached to the retaining cover. The reservoir chassis includes a main section that holds the bladder and an extension section connected to the main section. The retaining cover is attached to the reservoir chassis at a position adjacent to where the main section of the reservoir chassis connects to the extension section. The receiver is attached to either the retaining cover or the reservoir chassis adjacent to the position where the retaining cover is attached to the reservoir chassis. The slider is attached to the retaining cover such that the slider can slide to numerous positions along the retaining cover. The slider is sized and shaped to engage with the receiver.

Another object of the general inventive concept is to provide a method of making a pneumatically constricting tourniquet apparatus. The method includes sealing a bladder, inserting the bladder into a reservoir chassis, attaching a retaining cover to the reservoir chassis, connecting a receiver to either the reservoir chassis or the retaining cover, and connecting a slider to the retaining cover. In some embodiments, the bladder is formed from a single sheet of plastic, folded over along one edge and sealed along the other three edges so that the bladder holds and maintains air pressure while being inflated. The bladder is inserted into the reservoir chassis to hold and to protect the bladder. The reservoir chassis includes a main section that envelops the bladder and a reservoir chassis extension section that extends from the main section but does not envelop the bladder. The retaining cover is attached to the reservoir chassis where the main section and the chassis extension section connect. The retaining cover covers and protects the reservoir chassis.

A receiver is connected to either the reservoir chassis or the retaining cover at a location near where the retaining cover is attached to the reservoir chassis. The slider is connected to the retaining cover such that the slider can be slid to any point along the retaining cover. The receiver and slider are sized and shaped such that the slider is temporarily locked in position on the retaining cover as a friction buckle when engaged with the receiver.

Another object of the general inventive concept is to provide a method of making a pneumatically constricting tourniquet apparatus. The method includes placing a bladder into a reservoir chassis, attaching a retaining cover to the reservoir chassis, attaching a receiver to the retaining cover or the reservoir chassis, and attaching a slider to the retaining cover. The reservoir chassis includes a main section that holds the bladder and an extension section

connected to the main section. The retaining cover is attached to the reservoir chassis at a position adjacent to where the main section of the reservoir chassis connects to the extension section. The receiver is attached to either the retaining cover or the reservoir chassis adjacent to the position where the retaining cover is attached to the reservoir chassis. The slider is attached to the retaining cover such that it can be slid along the retaining cover. The slider is sized and shaped to engage with the receiver.

The foregoing and other objects are intended to be illustrative of the invention and are not meant in a limiting sense. Many possible embodiments of the invention may be made and will be readily evident upon a study of the following specification and accompanying drawings comprising a part thereof. For example, dimensional values included herein are provided for exemplary purposes, and embodiments of the present invention contemplate tourniquets or tourniquet components having a various dimensional values. Furthermore, various features and subcombinations of invention may be employed without reference to other features and subcombinations. Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, wherein is set forth by way of illustration and example, an embodiment of this invention.

Drawings

Embodiments of the invention are set forth herein and are shown in the following drawings:

FIG. 1 shows an exemplary pneumatic tourniquet according to embodiments of the present invention.

FIG. 2 shows an exemplary bladder that can be positioned within a reservoir chassis of the tourniquet from FIG. 1.

FIG. 3 shows an exemplary receiver of the tourniquet from FIG. 1.

FIG. 4 shows an exemplary slider of the tourniquet from FIG. 1.

FIG. 5 shows an additional view of a pneumatic tourniquet according to embodiments of the present invention.

FIG. 6 shows an additional view of a pneumatic tourniquet according to embodiments of the present invention.

FIG. 7 shows an additional view of a pneumatic tourniquet according to embodiments of the present invention.

FIG. 8 shows another exemplary bladder that can be positioned within a reservoir chassis of the tourniquet from FIG. 1.

Detailed Description

The following detailed description of the invention references the accompanying drawings that illustrate specific embodiments in which the invention can be practiced. The embodiments are intended to describe aspects of the invention in sufficient detail to enable those skilled in the art to practice the invention. Other embodiments can be utilized and changes can be made without departing from the scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense.

In this description, references to "one embodiment," "an embodiment," or "embodiments" mean that the feature or features being referred to are included in at least one embodiment of the technology. Separate references to "one embodiment," "an embodiment," or "embodiments" in this description do not necessarily refer to the same embodiment and are also not mutually exclusive unless so stated and/or except as will be readily apparent to those skilled in the art from the description. For example, a feature, structure, act, etc. described in one embodiment may also be included in other embodiments, but is not necessarily included. Thus, the present technology can include a variety of combinations and/or integrations of the embodiments described herein.

With reference to the figures, and in particular FIG. 1, embodiments of the present invention are directed to a pneumatic tourniquet for restricting a blood flow in a body part, such as an upper or a lower extremity, with the tourniquet comprising: (a) a bladder 200 (See FIGS. 2 and 8) sealed from 3 edges to hold and maintain air pressure while being inflated with an inflation pump 108; (b) a reservoir chassis 102 to hold and to protect the bladder 200, with the reservoir chassis 102 including a main section that holds the bladder 200 and a reservoir chassis extension section 101 that extends from the main section but does not hold the bladder 200; (c) a retaining cover 103 that is attached to the reservoir chassis 102 where the main section and the chassis extension section connect, with the retaining cover 103 operable to cover and protect the reservoir chassis 102 (d) a receiver 106 (See also FIG. 3) connected to either the reservoir chassis 102 or the retaining cover 103 proximate to where the retaining cover 103 is attached to the reservoir chassis 102, with the receiver 106 being operable to accept a slider 107 (See also FIG. 4) that is positioned on the retaining cover 103 from any position along the retaining cover 103, and furthermore with the receiver 106 being operable to allow a user to "snap" the slider

107 into place and lift the lip 303 of the receiver 106 to remove the slider 107 upon demand; (e) the slider 107 serves as a friction buckle operable to be placed along any section of the retaining cover 103, with the slider 107 including one round side bar 401 and one square side bar 402 with grippers 405 allowing for free rotation when attached to the receiver 106. In operation, the pneumatic tourniquet (See also FIGS. 5-7) is operable, via the above described components (a-e), to form a continuous loop around an extremity, such as an arm or a leg, so as to create a circumferential pressure that will restrict blood flow. Such a circumferential pressure is created by and 1) joining the slider 107 and the receiver 106 together and manipulating the retaining cover 103 so as to reduce the circumference of the tourniquet, and 2) pumping air into the bladder 200.

With respect to FIG. 1 (see also FIGS. 5-7), the reservoir chassis 102 retains and protects the air bladder 200. In some embodiments, the total length is 33 inches and the width is between 2 and 4 inches. In some embodiments, the reservoir chassis 102 includes a section of dual hook and loop fasteners on both sides of the reservoir chassis faces. In other words, the dual hook and loop fasteners are on the side facing "in" and the side facing "out." The tourniquet also includes a retaining cover 103 sized and shaped to overlap the reservoir chassis 102 as a secondary securing mechanism to prevent slippage or pressure reduction. The retaining cover 103 also provides extra protection for the reservoir chassis 102 and bladder 200. The outer surface of the retaining cover 103 includes dual hook and loop fasteners. The reservoir chassis extension 101 does not contain the bladder 200. The reservoir chassis extension 101 is sized and shaped to accommodate larger arm or leg circumferences. In some embodiments, the reservoir chassis 102 and/or the retaining cover 103 further include a blank label 109. The blank label 109 may be

used to write the time when the tourniquet is applied or various other relevant notes regarding patient care.

Extending from the bladder 200 (see also FIGS. 2 and 8) is a nipple 104 that connects the bladder to an air pump. In some embodiments, a half bulb inflation pump 108 is used to pump air into the bladder 200 via the nipple 104. In some embodiments, the half bulb inflation pump 108 is latex free and ergonomically designed for ease of use. In some embodiments, the inflation mechanism includes a relief valve 105 to manually control the release of pressure inside the bladder 200. In some embodiments, the inflation includes a metal clamp 201, such as a small brass ring, attached to the connection between the nipple 104 and the relief valve 105 or inflation pump 108.

In more detail, the retaining cover 103 (See FIGS. 1 and 5-7) includes dual hook and loop (i.e., Velcro) on its exterior surface and a nylon denier on its interior surface (i.e., the surface that faces the bladder 200). Thus, the retaining cover 103 is operable to cover and protect the reservoir chassis 102 and also operable to secure the tourniquet around an extremity. For example, the retaining cover 103 can be positioned in a continuous loop around an extremity by wrapping the retaining cover 103 around the extremity. Next, the slider 107, which is adjustably secured to the retaining cover 103, can be secured to the receiver 106, which is fixably connected to either the reservoir chassis 102 or the retaining cover 103, as previously described. In such an arrangement, the diameter of the continuous loop can be shortened by pulling the retaining strap further through slider 107, thus creating an increased circumferential pressure (i.e., a radial compression). Once a preferred diameter has been obtained, such a diameter can be maintained

by folding the retaining cover 103 back upon itself and securing such a position via the hook and loop of the retaining cover 103.

In some embodiments, the bladder 200 (See FIGS. 2 and 8) of the pneumatic tourniquet is formed from a polyurethane plastic material by sealing 3 edges of the plastic material. Furthermore a nipple 104 is attached to the polyurethane plastic and extends therefrom at an approximately 90 degree angle. From the nipple 104, a silicon tube 202 extends a distance and connects with the pump 108, which may, in some embodiments include a semicircle pressure inflation bulb (e.g., an ergonomically designed hemicycle pressure pump). Embodiments in which the pump 108 is a semicircular face may be preferable in instances when the tourniquet is required to be packaged in a small space. In certain embodiments, the bladder 200 is preferred to hold at least 450 mmHg of pressure, so as to be sufficient to stop blood flow and hemorrhage in an extremity. In other embodiments, the bladder 200 will hold more or less than 450 mmHg. In some embodiments, the bladder 200 will be approximately 25 inches in length, so as to be sufficient for use with human extremities (i.e., arms and legs) that have sizes within the 5th to 95th percentile. Regardless, embodiments of the present invention contemplate bladder lengths that are more or less than 25 inches. Furthermore, in some embodiments, the width of the bladder will be approximately 1.5 inches, which proves for a broad pressure base that can be applied to an extremity. However, it is understood that widths more or less than 1.5 inches may be used in some embodiments. The bladder 200 will, in some embodiments, also include a relief valve 105 that provides for a manual or automatic release of air pressure within the bladder 200.

Embodiments of the present invention provide for the reservoir chassis 102 (See FIGS. 1 and 5-7) to protect the bladder 200 (See also FIGS. 2 and 8) from environmental damages that

may occur during transportation or use of the tourniquet. In some embodiments, the reservoir chassis 102 will be formed in a coyote brown color to uniquely identify a first application of the tourniquet over the circumference of the damaged extremity. In some embodiments, a length of the reservoir chassis 102 is approximately 33 inches. However, in other embodiments, the chassis 102 may be more or less than 33 inches. With the total length of the reservoir chassis 102 being 33 inches, some embodiments provide for the main section to be about 25 inches length (or at least long enough to hold the bladder 200), and the extension section 101 to be about 8 inches in length. In some embodiments, the extension section 101 is included so as to provide for the comfortable placement of the tourniquet onto larger sized extremities. Further, some embodiments provide for two sections of approximately 16 inches of hook and loop to be positioned on an interior and exterior surface of the reservoir chassis. In particular, a first section of hook and loop is positioned on the exterior surface of the reservoir chassis 102 adjacent to an end of the reservoir chassis 102 that is opposite the extension section 101. In some embodiments, more or less than 16 inches of hook and loop will be added to the reservoir chassis 102. In certain additional embodiments, the interior surface of the reservoir chassis 102 will have a section of hook and loop thereon, with the section covering the extension section 101 and extending from the extension section 101 along a portion of the main section. In such embodiments, the main section of the reservoir chassis 102 can be wrapped around an extremity and can be secured in place by connecting the dual hook and loop on the outer surface of the main section with the dual hook and loop on the interior surface of the extension section 101. As such, the tourniquet can be initially positioned over and secured to an extremity until the slider 107 can be connected to the receiver 106 and the retaining cover 103 tightened and secured in a preferred position. Once the retaining cover 103 is tightened and secured in a preferred position,

the bladder 200 can be pumped up and filled with air to create the intended circumferential pressure to stop hemorrhaging and blood loss.

In some embodiments, the pneumatic tourniquet includes the retaining cover 103 (See FIGS. 1 and 5-7) which is sewn with nylon coated fabric and dual hook and loop, as previously described. In some embodiments, the retaining cover 103 is approximately 39 inches length. In other embodiments, the retaining cover 103 may be more or less than 39 inches. The retaining cover 103 preferably overlaps the reservoir chassis 102 as a secondary securing mechanism to prevent any slippage and provides extra protection. The retaining cover 103 includes a time label 109 which is comprised of a clothing label and is inserted on an end of the cover to write the time when application of the tourniquet is made.

Additional embodiments of the present invention include a tourniquet (See FIGS. 1 and 5-7) that is operable for restricting a flow of blood in a body part, such an upper or a lower extremity, with such a tourniquet comprising: (a) a bladder 200 (See FIGS. 2 and 8) placed into a reservoir chassis 102, with the reservoir chassis 102 including a main section that holds the bladder 200 and an extension section 101 connected to said main section; (b) a retaining cover 103 attached to the reservoir chassis 102 at a position adjacent to where the main section of the reservoir chassis 102 connects to the extension section 101; (c) a receiver 106 (See also FIG. 3) joined with the retaining cover 103 or the reservoir chassis 102 adjacent to the position where the retaining cover 103 is attached to the reservoir chassis 102; and (c) a slider 107 (See also FIG. 4) attached to the retaining cover 103 for quick application to the receiver 106. In such embodiments, when the tourniquet is placed onto the damaged circumference of the extremity, the slider 107 can be attached to the receiver 106 and then the retaining cover 103 can be

adjusted to a preferred position so as to create a circumferential pressure. Furthermore, the retaining cover 103 can be secured in such a position by folding an end of the retaining cover 103 back on itself such that the dual hook and loop of the retaining cover 103 secures the retaining cover 103 in place.

As illustrated in FIG. 3, the receiver 106 includes a hook-shaped catch 301 that the round side bar 401 of the slider 107 (See FIG. 4) can be placed into or removed from by the user on demand through application of the receiver flange 302. A lip portion 303 of the receiver is the narrower portion of the receiver 106 and facilitates ease of placement for the round side bar 401 of the slider 107, and the bar locks the hook slider into place.

With respect to FIG. 3, in some embodiments, the hook-shaped catch 301 (or slider niche) is sized and shaped to mate with and receive the slider 107 and lock the slider 107 securely in place. The receiver flange 302 guides and provides an easy placement for the slider 107 which locks the retaining cover 103 in place. The flange 302 slopes upward to facility placement. The lip 303 is a narrower part of the receiver 106 to provide an easy placement with the receiver flange 302 for the slider 107. A bar 304 hangs down from the lip 303. The bar 304 supports locking of the hook slide and prevents unintentional displacement (dislodging) of the slider 107 from the receiver 106. The bar 304 allows the slider 107 to "snap" or audibly "click" when the slider 107 and receiver 106 are properly mated. A supporter 306 is a thicker portion of the receiver 106 that structurally supports the receiver slot 305. The receiver slot 305 is a space for a receiver holder to connect the receiver 106 to the retaining cover 103 or reservoir chassis 102.

With reference to FIG. 4, the slider 107 functions as a friction buckle that is operable to be placed anywhere on the retaining cover 103. The square side bar 402 of the slider 107 with protruding grippers 405 facilitates friction when the round side bar 501 is placed into the receiver 106 (See FIG. 3). As such, the slider 107 reduces slippage, yet allows excess slack to be removed from the diameter of the circumferential tourniquet body upon demand from the user with an upward pulling motion of the retaining cover 103. Furthermore, the retaining cover 103 can be pre-routed through the slider 107, thus avoiding the necessity to route the retaining cover 103 through the slider 107 during use.

With respect to FIG. 4, in some embodiments, the slider 107 includes a round edge 401 (or round side bar). The round side bar 401 is sized and shaped to interface with the receiver 106. The round side bar 401 is sized and shaped to allow for articulation when mated with the receiver 106. The slider 107 further includes a frame 402 (or square side bar). The square side bar 402 gives support, structure and shape to the slider 107. In some embodiments, the slider 107 will be a distinctive color to easily and quickly visually distinguish the slider's position relative to the retaining cover 103. For example, in some embodiments, the slider 107 is coyote brown. In some embodiments, the slider 107 includes a slider friction bar 403. The slider friction bar 403 provides friction and inhibits the release of tension when the tourniquet is applied. The friction bar 403 is positioned higher than the side bars 401 and 402. The friction bar 403 is sized and shaped to lock the slider 107 in position when the tourniquet is applied. The slider 107 further includes slider gaps 404. The retaining cover 103 is routed through the slider gaps 404 with dual hook and loop fasteners on the retaining cover 103 side that faces toward the slider friction bar 403. The square side bar 402 of the slider 107 also includes grippers 405. The grippers 405 facilitate friction when the round slider bar 401 is placed into the receiver 106. This stops

slippage, yet allows excess slack to be removed from the retaining cover 103 continuous loop upon demand with an upward pulling motion of the retaining cover 103.

Together, the slider 107 (See FIG. 4) and the receiver 106 (See FIG. 3) function as a buckle, so as to create a continuous loop of the tourniquet. Adjustments can be made, via the slider 107, for shortening or lengthening the continuous loop once applied, and/or the slider 107 can be attached or detached from the receiver 106 to facilitate ease of application by the user.

In some embodiments, certain portions of the tourniquet, such as the reservoir chassis 102 and the retaining cover 103 may be made from various types of elastic and/or inelastic flexible material, such as woven fabric, vinyl, leather, neoprene, nylon, etc. Additionally, other components of the tourniquet (e.g., receiver 106 and slider 107) may be made from rigid or semi-rigid materials, such as various types plastics, metals, or the like. Furthermore, portions of the bladder 200, including the bladder 200 itself or the nipple 104, tubing 202, and pump 108, may be made from various materials that are flexible but operable to securely hold fluid therein, such as neoprene, polyurethane, other plastic, or other similar material.

While the present general inventive concept has been shown in the drawings and fully described above with particularity and detail in connection with what is presently deemed to be the most practical and preferred embodiment(s) of the invention, it will be apparent to those of ordinary skill in the art that many modifications thereof may be made without departing from the principles and concepts set forth herein, including, but not limited to, variations in size, materials, shape, form, function and manner of operation, assembly and use.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween. Hence, the proper scope of the present general inventive concept should be determined only by the broadest interpretation of the appended claims so as to encompass all such modifications as well as all relationships equivalent to those illustrated in the drawings and described in the specification.

Finally, it will be appreciated that the purpose of the annexed Abstract is to enable the U.S. Patent and Trademark Office and the public generally, and especially the scientists, engineers and practitioners in the art who are not familiar with patent or legal terms or phraseology, to determine quickly from a cursory inspection the nature and essence of the technical disclosure of the application. Accordingly, the Abstract is neither intended to define the invention or the application, which only is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

CLAIMS

What is claimed is:

1. A blood-flow restriction tourniquet apparatus comprising:

an elongated bladder sealed along at least 3 edges to hold and maintain air pressure while being inflated with an inflation pump;

an elongated reservoir chassis to hold and to protect the bladder, the reservoir chassis including a main section that envelops the bladder and a reservoir chassis extension section that extends from the main section but does not envelop the bladder;

a retaining cover attached to the reservoir chassis where the main section and the chassis extension section connect, with the retaining cover operable to cover and protect the reservoir chassis;

a receiver connected to one of the reservoir chassis or the retaining cover proximate to where the retaining cover is attached to the reservoir chassis;

a slider connected to the retaining cover such that the slider can be positioned at any point along the retaining cover, the receiver and slider being sized and shaped such that the slider is temporarily locked in position on the retaining cover as a friction buckle when engaged with the receiver.

2. The blood-flow restriction tourniquet apparatus of claim 1, wherein the slider includes a round side bar and a square side bar with a plurality of grippers.

3. The blood-flow restriction tourniquet apparatus of claim 1, wherein when the slider and receiver are mated together, a continuous loop is created that, when placed around a limb, establishes circumferential pressure around the limb.

4. The blood-flow restriction tourniquet apparatus of claim 1, wherein the receiver includes a hook-shaped catch into which the slider can be placed or removed.

5. The blood-flow restriction tourniquet apparatus of claim 4, wherein a lip portion of the receiver is narrower than the receiver and facilitates ease of placement of the slider and locks the hook-shaped catch and slider into place.

6. The blood-flow restriction tourniquet apparatus of claim 1, wherein the retaining cover is comprised of woven fabric, vinyl, leather, neoprene, or nylon.

7. The blood-flow restriction tourniquet apparatus of claim 1, wherein one of the receiver or slider is comprised of plastic or metal.

8. A blood-flow restriction tourniquet apparatus comprising:

a bladder placed into a reservoir chassis, the reservoir chassis including a main section that holds the bladder and an extension section connected to said main section;

a retaining cover attached to the reservoir chassis at a position adjacent to where the main section of the reservoir chassis connects to the extension section;

a receiver attached to the retaining cover or the reservoir chassis adjacent to the position where the retaining cover is attached to the reservoir chassis; and

9. a slider attached to the retaining cover sized and shaped to engage with the receiver, the slider being sized and shaped such that the slider can be positioned at any one of a plurality of positions along the retaining cover. A method of making a blood-flow restriction tourniquet apparatus, the method comprising:

sealing an elongated bladder along at least 3 edges such that the bladder will hold and maintain air pressure while being inflated with an inflation pump;

inserting the bladder into an elongated reservoir chassis to hold and to protect the bladder, the reservoir chassis including a main section that envelops the bladder and a reservoir chassis extension section that extends from the main section but does not envelop the bladder;

attaching a retaining cover to the reservoir chassis where the main section and the chassis extension section connect, with the retaining cover operable to cover and protect the reservoir chassis;

connecting a receiver to one of the reservoir chassis or the retaining cover proximate to where the retaining cover is attached to the reservoir chassis;

connecting a slider to the retaining cover such that the slider can be positioned at any point along the retaining cover, the receiver and slider being sized and shaped such that the slider is temporarily locked in position on the retaining cover as a friction buckle when engaged with the receiver.

10. A method of making a blood-flow restriction tourniquet apparatus, the method comprising:

placing a bladder into a reservoir chassis, the reservoir chassis including a main section that holds the bladder and an extension section connected to said main section;

attaching a retaining cover to the reservoir chassis at a position adjacent to where the main section of the reservoir chassis connects to the extension section;

attaching a receiver to the retaining cover or the reservoir chassis adjacent to the position where the retaining cover is attached to the reservoir chassis; and

attaching a slider to the retaining cover, the slider being sized and shaped to engage with the receiver.

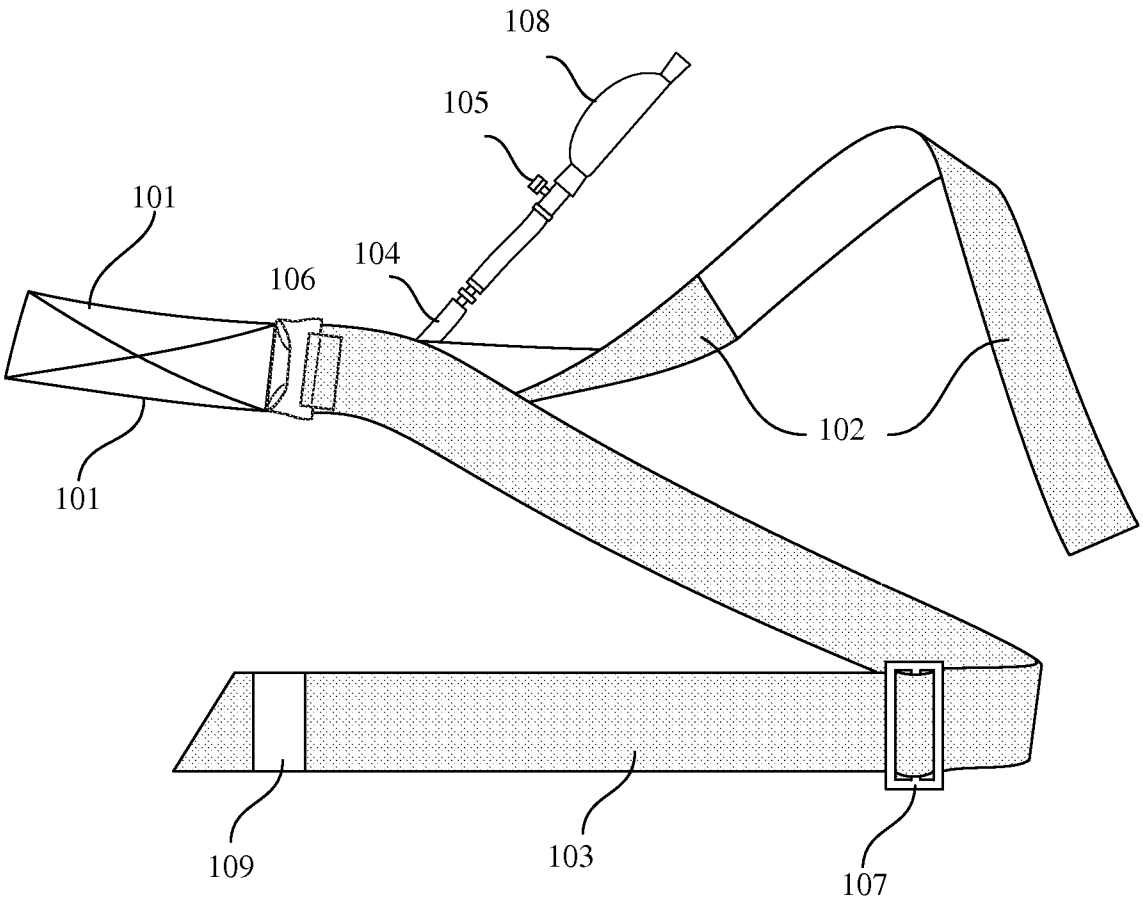


FIG. 1

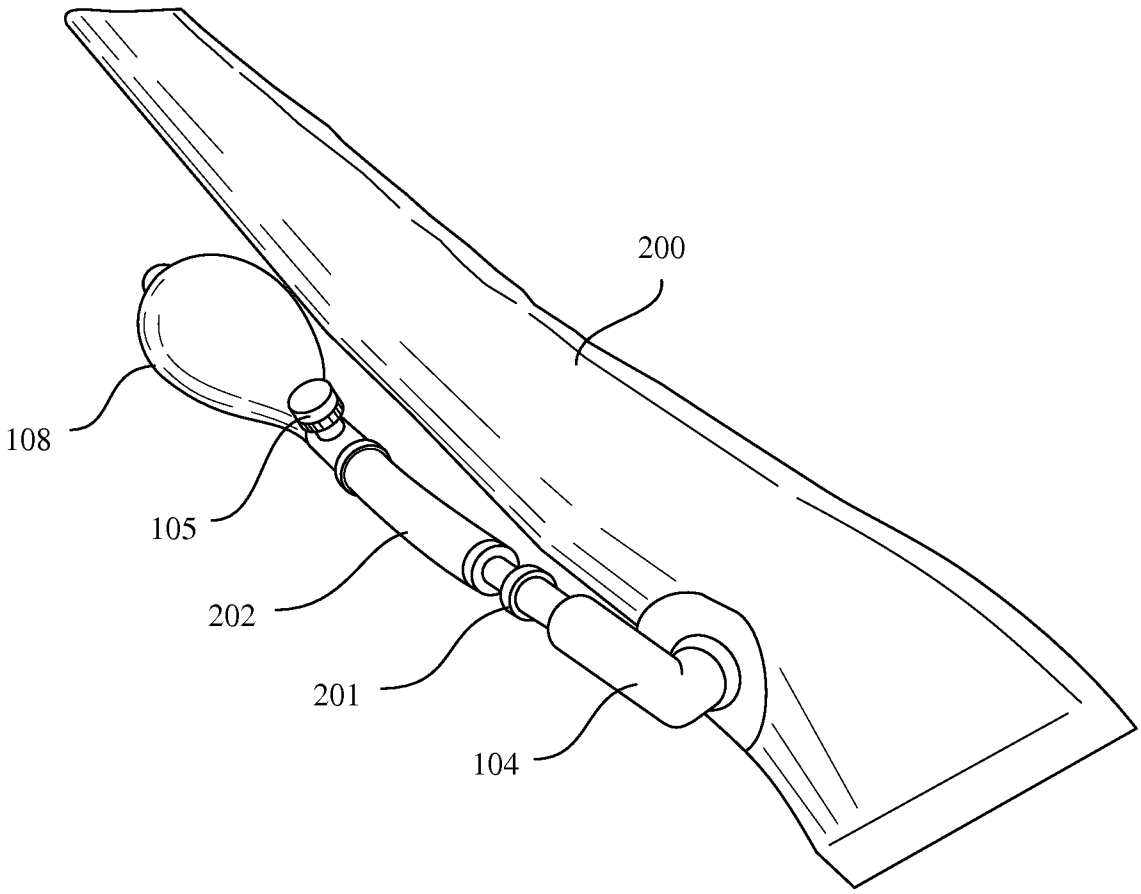


FIG. 2

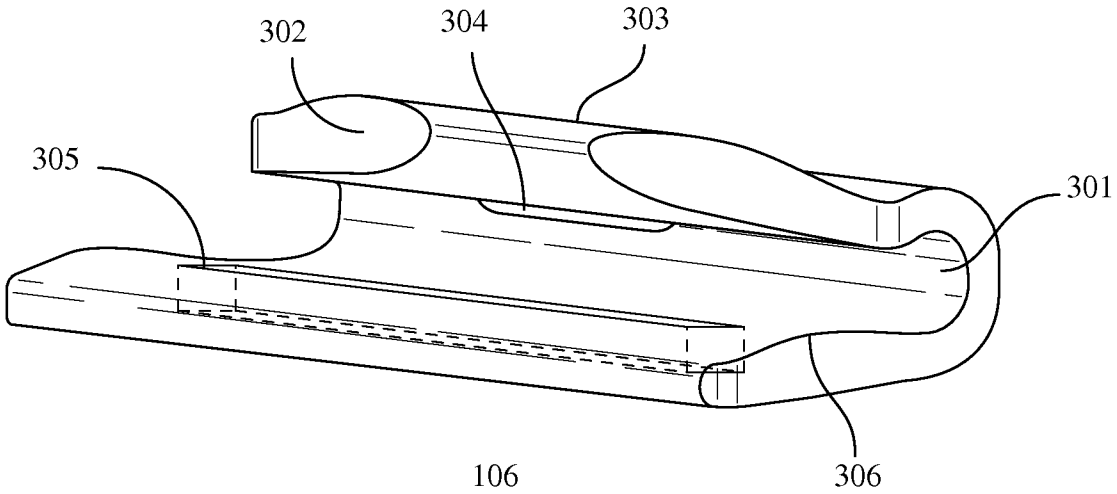


FIG. 3

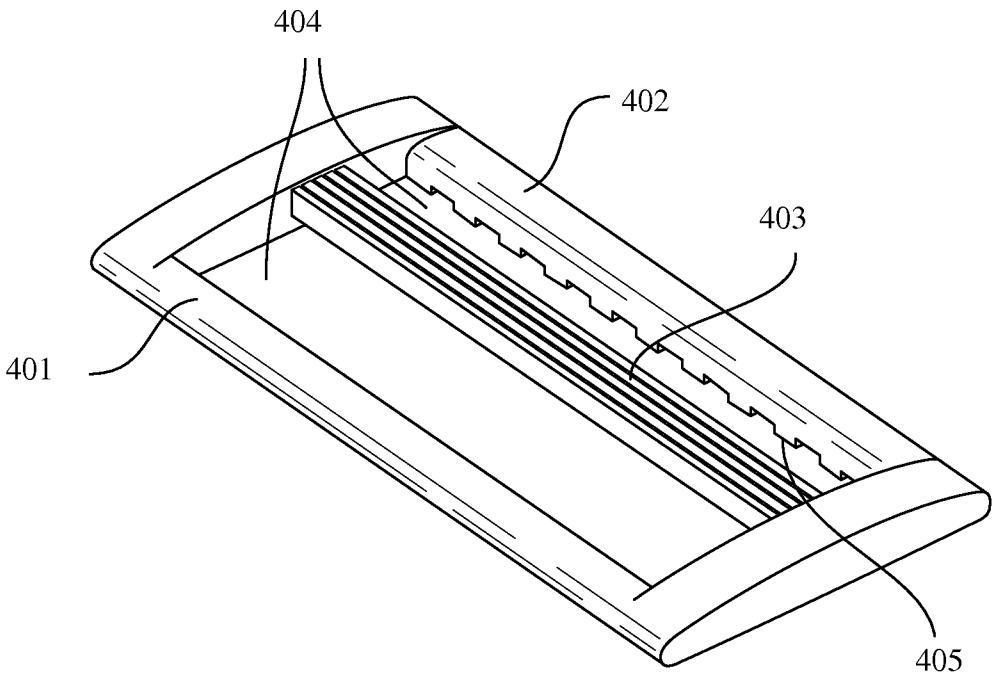


FIG.4

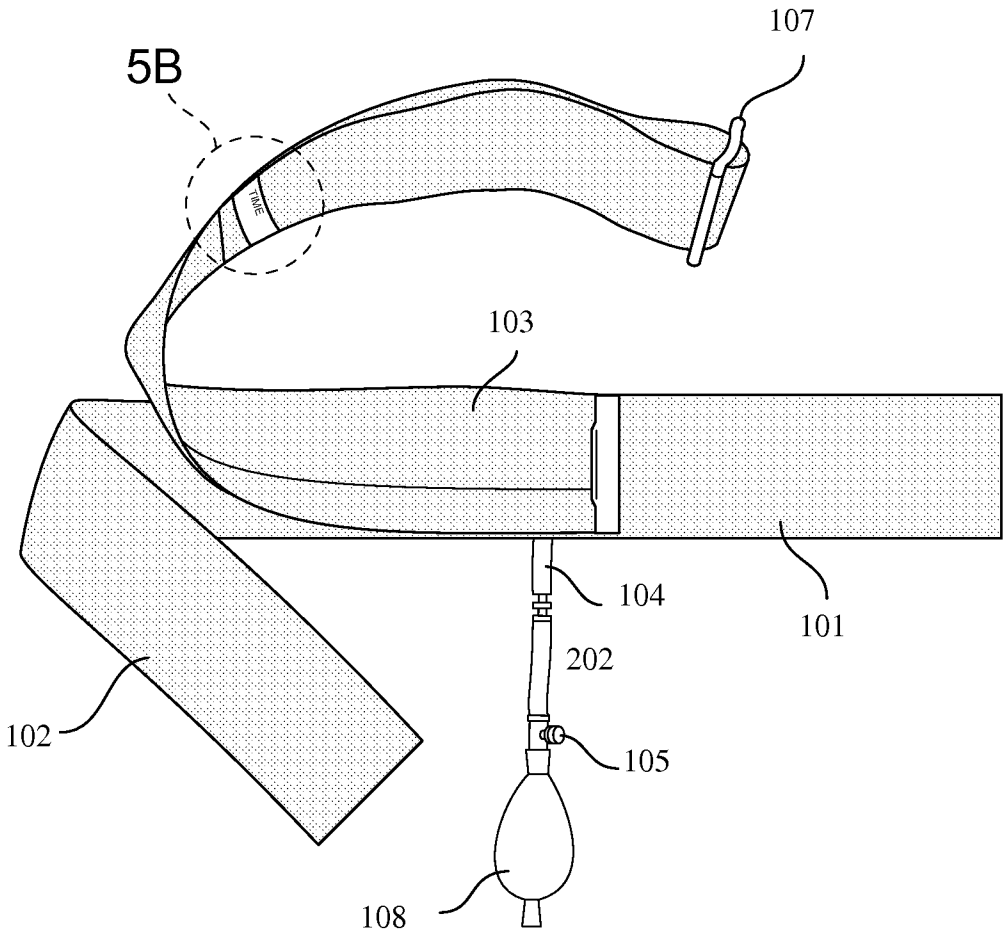


FIG. 5A

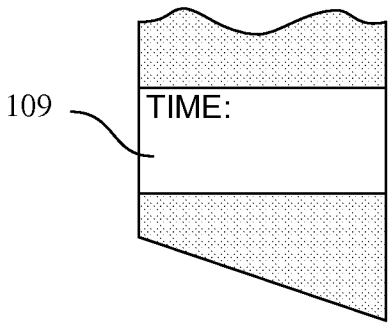


FIG. 5B

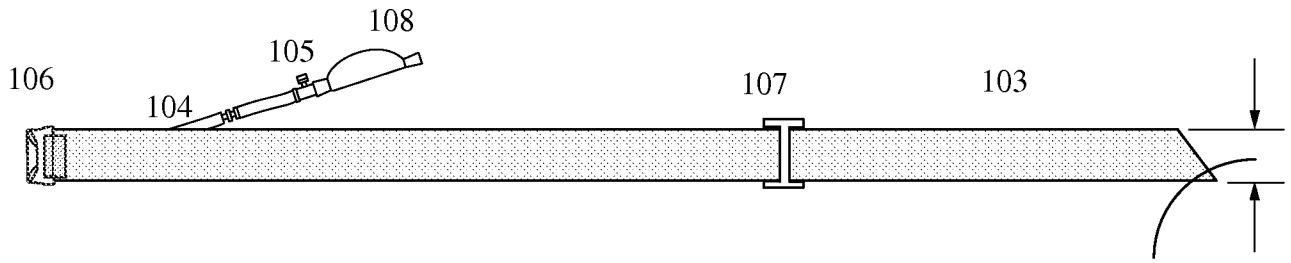


FIG. 6

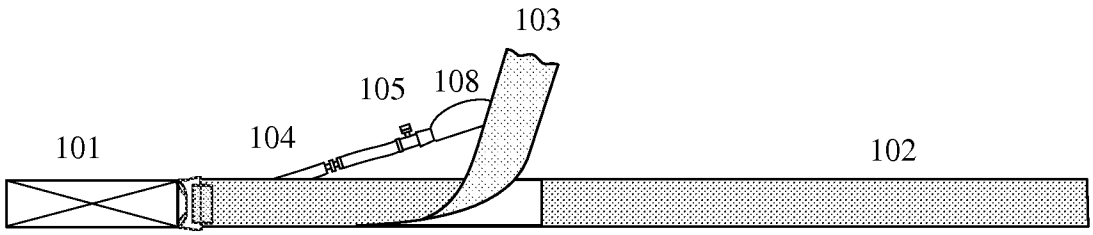


FIG. 7

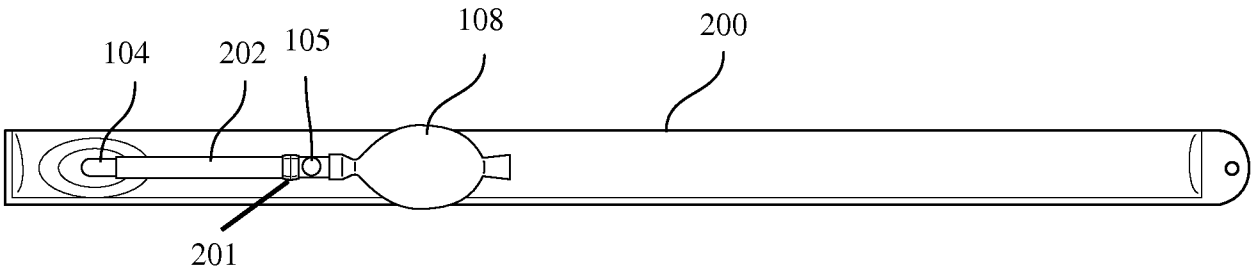


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/058098

A. CLASSIFICATION OF SUBJECT MATTER

A61B 17/132(2006.01)i

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)
A61B 17/132; A61B 17/00; G01L 5/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: pneumatic, tourniquet, bladder, receiver, slider, hook-shape, catch, gripper

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6746470 B2 (MCEWEN et al.) 08 June 2004 See column 5, line 14-column 9, line 55; claims 1-11; and figures 1-6.	1-10
Y	US 1406770 A (SMITH, JAMES P.) 14 February 1922 See page 1, line 9-page 2, line 30; claims 1, 2; and figures 1-9.	1-10
A	US 5413582 A (EATON, ROBERT P.) 09 May 1995 See column 3, line 55-column 7, line 20; claims 1-4; and figures 1-15.	1-10
A	KRAGH JR. et al., The military emergency tourniquet program' s lessons learned with devices and designs, Military Medicine, 2011, Vol. 176, No. 10, pp. 1144-1152 See pages 1144-1152.	1-10
A	US 2012-0071917 A1 (MCDONALD et al.) 22 March 2012 See paragraphs [0099]-[0165]; claims 1-20; and figures 1-41.	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2015 (12.01.2015)	**12 January 2015 (12.01.2015)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/058098

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6746470 B2	08/06/2004	US 2003-0139766 A1	24/07/2003
US 1406770 A	14/02/1922	None	
US 5413582 A	09/05/1995	None	
US 2012-0071917 A1	22/03/2012	WO 2013-040359 A1	21/03/2013