This document is a request for a patent from the Canadian Intellectual Property Office.

Date:

Sept 19, 2019

Applicant and Inventor:

Stephen E. Bruneau
13 Darcy Street
St John's, NL, Ca
A1A 5B9
sbruneau@mun.ca
709 693 7862

Agent:

No patent agent has been retained for this application.

Small Entity Declaration:

I am representing myself as a sole proprietorship and am, therefore, declaring myself to be in the category of a small entity.

Title:

Anchoring Device and Platform for Instruments on Icebergs

Anchoring Device and Platform for Instruments on Icebergs

Abstract

The invention is an anchoring device and platform for small instruments that are to be placed on icebergs using remote control deployment. The device is formed in the preferred embodiment of three transverse beams fastened to one another resulting in a rigid triangular frame, and in addition three rods passing perpendicular through the intersection of the bars resulting in legs supporting the triangular frame. The legs extend from both sides of the frame and are sharpened at both ends for efficient embedment into the ice. The beams extend beyond the intersection points so as to prevent the device from coming to rest in any orientation other than upon its three sharpened legs. The proportions of the lengths of the legs, the beams and the beam extensions are significant for functionality and are therefore specified. The invention is easily assembled in the field, is easily deployed owing to its self-righting capability and resistance to damage. It is functionally reliable as it has no moving parts and does not require any activation to achieve high stability immediately upon placement. The device may be considered disposable as it is low cost and safe for the environment.

Field of the Invention

The invention pertains to scientific and engineering investigations of floating icebergs in an ocean environment. The invention also relates to the new practice of deploying instruments in remote and dangerous locations using unmanned aerial vehicles (UAVs) under remote control. In addition, the invention relates to a mechanical means of gripping ice so as to prevent a body from moving once placed in contact with an ice surface.

The prior art of iceberg investigation using instruments in the field involved persons in possession of said instruments being transported by helicopter or vessel and being placed on an iceberg at considerable cost and personal risk. Thus the prior art also involves techniques for placing and anchoring instruments that are hand-controlled, often using drilled anchors at sites selected for convenience and reliability. The advent of inexpensive, small, instrument packages and the advancement of UAV capabilities have led to new deployment practices whereby recoverable and non-recoverable instruments may be taken to icebergs and dropped or placed on the iceberg surface using remote control. This new practice greatly reduces costs and risks to human safety, however, the placement and securing of the instruments on the iceberg surface cannot be controlled to the same extent as was the case by hand. Thus a new means of securing remotely placed instruments to icebergs is required and has until now been carried out with limited success in an ad hoc manner.

Related Background Art

Prior art that relates to the present invention are described in Canadian Patents as follows:

1000023 discloses an invention which is an anchor frozen into an ice sheet. The anchor is comprised of a high strength band that is melted into an ice mass in the configuration of a closed loop, resistance to withdrawal results from the structural resistance of intact competent ice contained within the loop.

1153531 describes an anchor that uses an active thermodynamic means of heating an element which sinks into an iceberg surface and then rotates so that resistance to withdrawal forms the basis of operation as an anchor. That system requires a source of heat and manual controls.

1220925 describes another ice anchor for attachment of probes or anchors to an iceberg in which a heat retaining elongated body has an ice penetrating end which is heat extruding. Resistance to withdrawal is achieved once the device has melted into the ice and over time freezes into position.

1230523 relates to a method and apparatus for moving ice masses. It is described as embodying a rotating annular head which melts a horizontal path into an ice mass which may then be split or towed according to the desired outcome.

2359094 describes a retrievable ice anchor for securing shelters to ice. It is a device lowered by an offset connector through a drilled hole in an ice sheet and is activated by pulling a secondary connector so that the device toggles and engages the underside of the sheet resisting withdrawal.

All of these devices require activation which involves the movement of parts or forced flow of heat. They also do not provide helpful resistance the instant contact with ice is first made. None of the embodiments are described in a way that would be suitable for remote deployment using UAVs due to weight, cost, and control limitations.

Prior art that relates to the present invention are also described in United States Patents as follows:

1386028 describes a device that attaches to the bottom of a boot to prevent slipping on ice and is comprised of straps, platforms hinges and studs.

3680645 describes a method and apparatus for drilling holes in ice by melting the ice at the bottom of a drill hole to form a water reservoir and cooling the wall to re-freeze the upper portion of the water reservoir so that a continuous ice shell is maintained around the drill hole.

4223627 describes a propulsion device for embedding in an iceberg. The claims include a platform to be installed into the wall of a tabular iceberg from which a propulsive force may be exerted, the method of embedment and placement are not claimed or described.

4427831 describes a rubber material having an excellent grip on ice comprising a mixture of an ordinary rubber and a powdered polymer of specified characteristics.

4640552 describes a method for splitting ice masses which involves a drilled borehole which is blocked and pressurized to split the ice mass.

4650115 describes a traction mat for use under a vehicle wheel to provide traction under conditions such as snow and ice. The mat generally includes a flat body having cleats which are moveable relative to the body. The cleats are disclosed as individual spike-like members mounted in the mat elements which are generally arranged in parallel rows. The spikes are axially moveable between inoperative positions and operative positions gripping the ground in response to the vehicle wheel moving over the spikes.

4815997 describes a set of ice prods each of which comprises a handgrip having attached to one end and a metal spike extending out the other end.

4865571 describes a hand-held ice grab and water paddle comprised of a flat rigid rectangular plate with four corners bent down to form a rigid v-shaped points to grip on an ice surface.

5971688 describes a portable anchor for tethering to a shelf of a rock quarry including an elongated lower post adapted to slip into pre-drilled charge holes.

5782442 describes an ice screw with a foldable crank handle. It is comprised of a hollow tubular shaft with external threads formed on the shaft and the hanger attached to the shaft. The hangar has an eye for clipping a carabiner and the handle is pivotally attached to the hanger so as to perform as a crank handle when driving the shaft into ice.

6827994 describes a portable weighted gripping device which provides a means for securing a beach towel or blanket or other item on a beach, lawn or other location. It comprises a container sized to receive a weight such as sand, and a slotted diaphragm of flexible resilient material shaped to receive and secure the edge or corner of the item to be secured.

6966127 describes an ice spike comprised of a fixing clamp attached to the fixed rear part of the armature and having a cross-bar designed to latch directly on to the rear sole of a mountaineering boot. It has a strapping mechanism and plurality of metal spikes for engaging ice.

8006780 describes a method of attachment of a towing anchor to an iceberg. It involves a drilling bit for penetrating an iceberg that utilizes a cutting head, a torque transmission body and a driving end. It also incorporates liquid nitrogen for refreezing water.

D780422 describes an ornamental design for a shoe ice grip accessory made of rubber and metal studs.

D680612 describes a tripod for use on ice and rocky surfaces configured to support a gun while shooting.

Disclosed in these US patents and those of other nations are methods of improving grip or anchoring on ice or rock for persons or tools operated by people. Neither patents nor the literature provide examples of passive ice anchoring devices which are well suited to remote deployment on variable ice surfaces.

Summary of Invention

The invention is a useful device for securing instruments to icebergs. It is most likely to be delivered to a floating iceberg by a UAV to which the device is attached by a tether. Once laid onto the ice surface the device is released from the tether by an operator activating a release switch on the UAV by remote control. The device is essentially a rigid triangular frame with pointed legs and extensions to optimize functionality.

The invention possesses numerous benefits and advantages over known ice anchor and instrument mounting systems. In particular the functionality does not rely on any activation, it is self-righting and becomes fully functional the instant it is deployed. The design is simple in form but considers carefully the characteristics of iceberg surfaces and deployment challenges in harsh environments. The length proportions of the legs, beams and extensions are defined within limits so that some adjustment for payload shape may be made while preserving the overall stability of the assembly. For instance leg extensions may be adjusted so that the payload remains suspended over the ice even if the ice surface is moderately curved – however the length of the beam extensions and overall beam lengths must remain in compliance with stated specifications. The payload is centered within the frame which enhances stability, lowering the center of gravity and virtually eliminating the risk of tumbling. The surrounding rigid frame also protects the instruments from damage during deployment and operation.

The design conscientiously maximizes the ice contact pressure by minimizing the number of sharp contact points with the ice. The taper of the beam ends and leg ends is specified within certain limits that ensure device strength and point retention while maximizing ice embedment.

The device is entirely passive eliminating the risk of mechanical malfunction. The rigid frame has no moving parts, and the payload in the preferred embodiment is likewise rigid and secured to the device by mechanical means.

The materials of construction may be mild steel for high strength, low cost and easy manufacture. In its simplest form the beam elements may all be identical and the leg elements may likewise be all identical resulting in the necessity to manufacture only two unique patterns repeatedly. An inventory of said parts and threaded nuts is efficiently and safely stored and transported to the field. The operational device in its preferred embodiment may be assembled by hand in minutes using only one wrench. By painting one of the three beams a contrasting color visual monitoring of the device from afar may be enhanced. The device may be considered disposable as its cost of manufacture is low and the materials of construction of the preferred embodiment are benign if left to decay on the seabed.

Fig. 1 is a top view of the anchor device

Fig. 2 is a front view of the anchor device

Fig. 3 is an oblique view of the anchor device

Fig. 4 is a conceptual illustration the device on an iceberg with an instrument payload attached

Fig. 5 shows examples of the manufacture patterns required for three embodiments of the device meeting varying weight criteria.

Detailed Description of the Invention

The device for which exclusive property and privilege is claimed is illustrated in Figures 1 to 5 elements of which are therein labeled to support the following description: three beam elements 1 and three leg elements 2 are rigidly fastened to one another using a mechanism such as threaded nuts 3 as shown in the preferred embodiment of the device as illustrated in Fig. 1 and Fig. 2 and Fig. 3.

The beam elements extend beyond the point of intersection by a distance 4a that is no more than twice the leg extension length 8, and no less than one half of the leg extension length 8. These beam extensions facilitate deployment by preventing the device from coming to a rest in any orientation other than upon its three pointed legs. The proportions of the device must fall within a specified range to ensure stability, those proportions being that the distance between legs 4b shall not be less than three times the leg extension length 8 and shall not be more than six times the leg extension length 8. The device in its preferred embodiment may come to rest on either side of the frame as the instruments are usually insensitive to orientation. The beam elements have tapered ends with sharpened tips 5. The leg elements are likewise tapered and sharpened 9. The taper of the legs and beams should result in an interior tip angle 5a and 9a no greater than 37 degrees and no less than 20 degrees. The beam elements have holes 6 or a plurality of same or some other means of mechanically attaching a payload to the interior of the triangular frame. The beam elements also have holes 7 or some other means of mechanically attaching a tether used to transport the device or to attach the device to other elements.

A mechanical spacer 10 is an optional element which may facilitate device assembly and rigidity. The assembled device shown in Fig. 3 is comprised of 13 components (three beams, three legs and seven nuts) which may be assembled easily in the field using one wrench. The device simplicity permits an efficient means of transporting and storing a plurality of components for assembly of multiple devices where and when needed. The capability of the device to grip ice is enhanced with increased sharpness of the protruding leg and beam tips. In its assembled form these sharp tips protrude in many directions making handling dangerous. It is viewed thus as an important design characteristic that the device may be assembled into its final form in the few moments prior to its deployment, reducing the danger to personnel in the field.

Fig.4 illustrates conceptually the device as it may appear in its deployed state on an iceberg 11 with its payload instrument package 12 in place. In this illustration of its preferred embodiment the payload is attached to the device with bolts 13. The legs of the device are shown to be made of threaded rod 15 the sharpened ends of which have become embedded into the ice 14. Despite the skewed aspect of the device in its deployed state in Fig. 4 it is in a stable condition. Over time the device legs will further penetrate the ice owing to the viscoelastic creep properties of ice. Heat absorbed from the air by the device may in time be conducted to the legs promoting melting which will result in further embedment and increased stability.

Fig. 5 illustrates patterns for the manufacture of three embodiments of the device. Three beam elements 16a and three leg elements 16b are required to make a device from mild steel having a final assembled mass of 1.5 kg. Also shown are the patterns for beam elements 17a and 18a and leg elements 17b and 18b for making devices from mild steel having a final assembled mass of 2.0 kg and 2.6 kg respectively.

Claims and Embodiments of the Invention in Which an Exclusive Property or Privilege is Claimed Are Defined As Follows:

1. An ice anchor comprised of three similar beams transversely assembled into a triangular formation, in which the intersection points of the beams are perpendicularly intersected by rods which form legs extending in both directions from the plane of the beam assembly. The beams and legs are fixed to one another by threaded nuts or other means so as to make an entirely rigid frame assembly. The extension of the beams are within 0.5 and 2 times the extension of the legs from the point of intersection. The span between legs is between three and six times the leg extension length. The tips of the beams and legs are tapered at an interior angle between 20 and 37 degrees and sharpened so as to engage and penetrate ice to prevent slippage wherever contacted.
2. An ice anchor as defined in claim 1 in which the interior of the triangular beam frame is sized according to the dimensions of the instrument payload.
3. An ice anchor as defined in claim 1 and claim 2 in which holes, clips or other means are provided for the mechanical attachment of instruments or other payloads to the interior of the device frame.
4. An ice anchor as defined in claim 1 and claim 2 and claim 3 in which the lengths of the legs are optimized to ensure the payload does not touch the ice surface yet the assembly retains a low center of gravity.
5. An ice anchor as defined in claim 1 and claim 2 and claim 3 and claim 4 in which the thicknesses and material composition of the elements are selected to optimize the overall weight of the assembly for maximum ice penetration within allowable payload limits.
6. An ice anchor as defined in all prior claims whereupon a light weight hemispherical dome is mechanically fastened to one side of the frame so that it envelopes that entire side forcing the assembly when released on the iceberg surface to self-right onto the legs protruding from the bottom. Such an embodiment being of use for instruments which may require specific orientation once deployed.
7. An ice anchor system in which two or more ice anchors as defined in all prior claims are tethered to one another forming a plurality of anchoring points spatially distributed on the ice surface.

Drawings:

Fig. 1

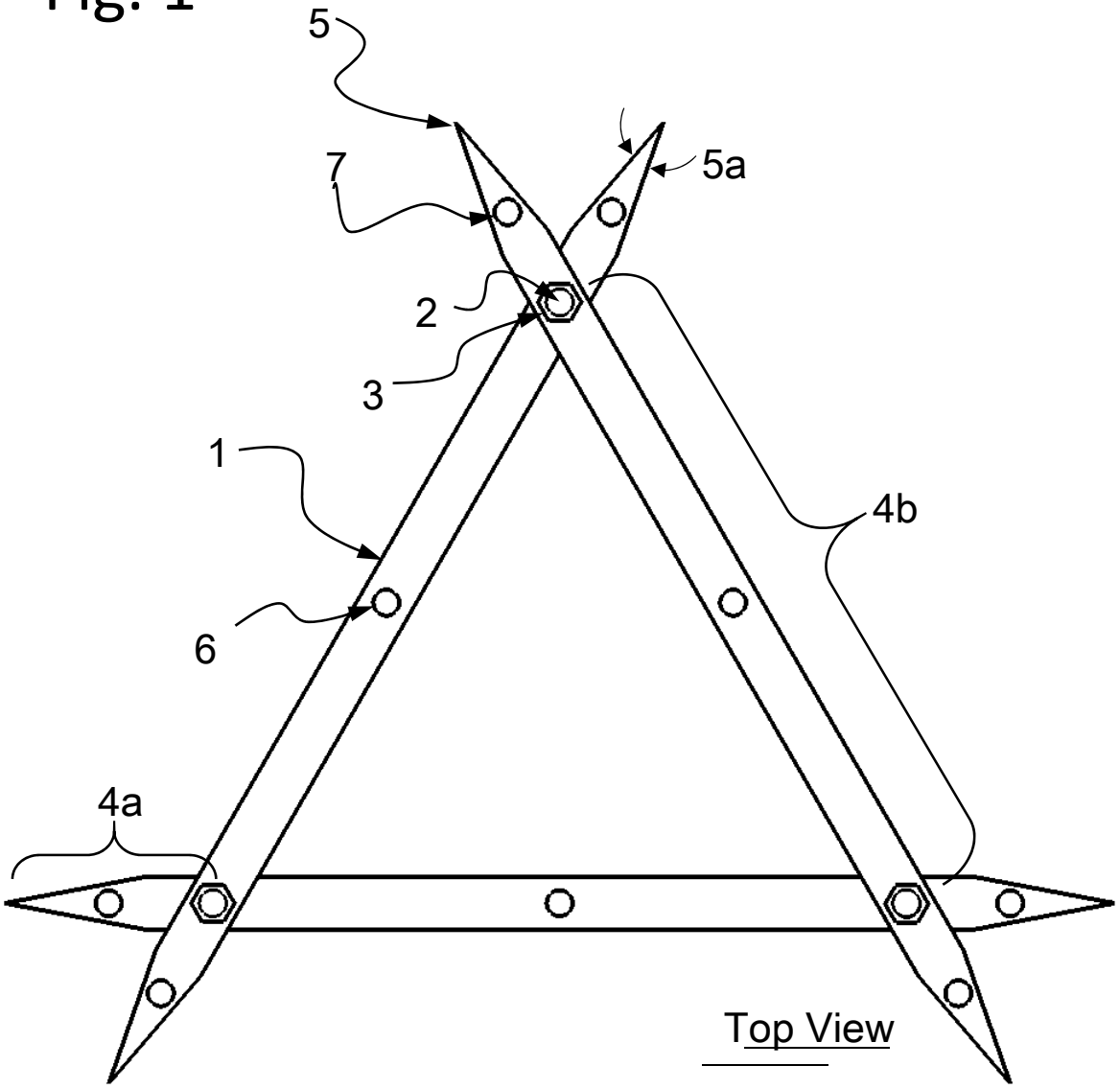


Fig. 2

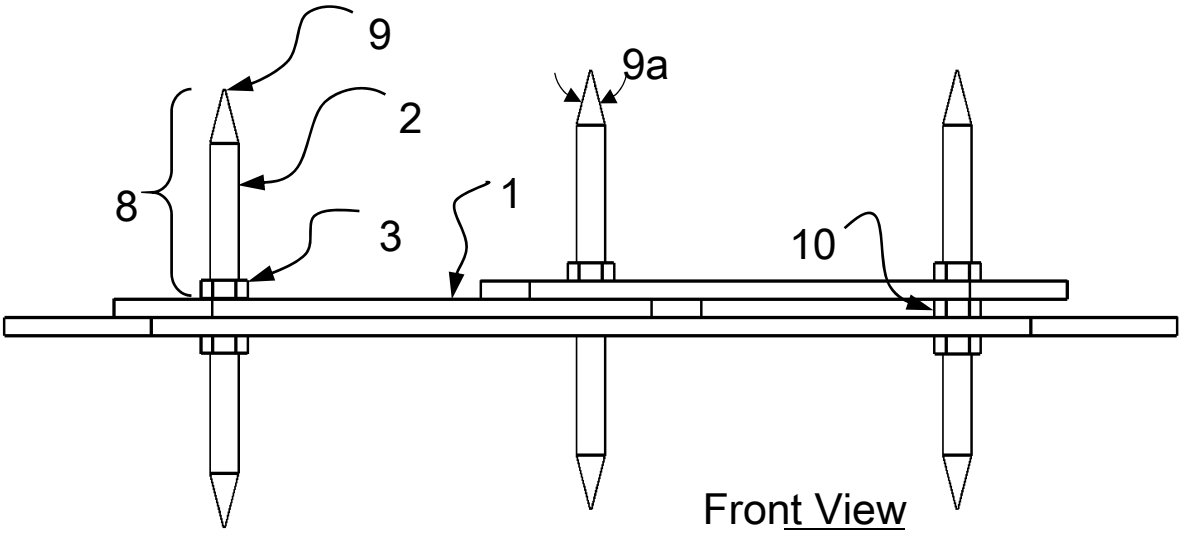
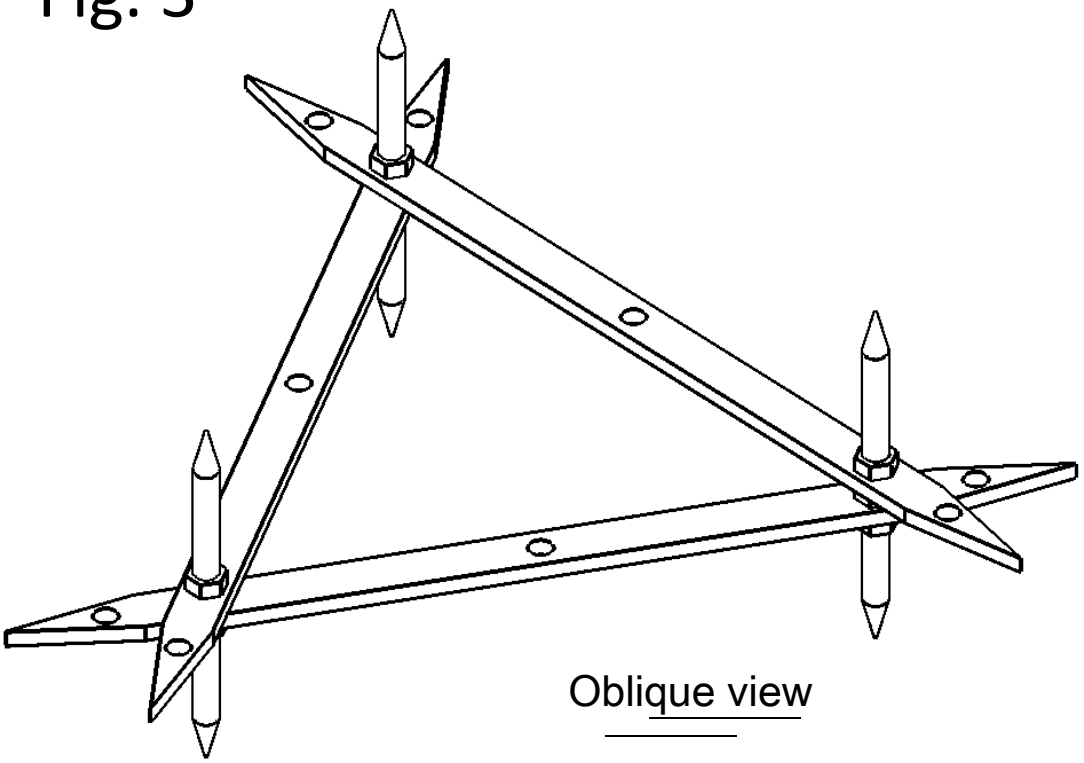
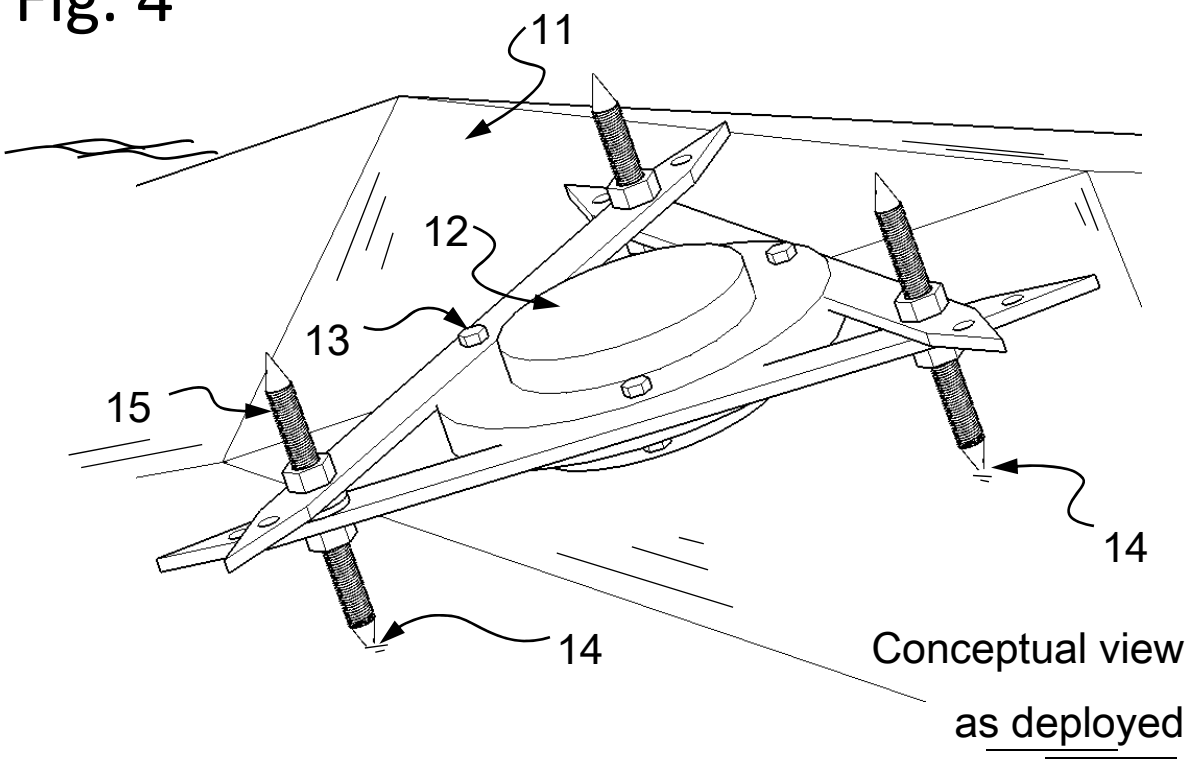


Fig. 3



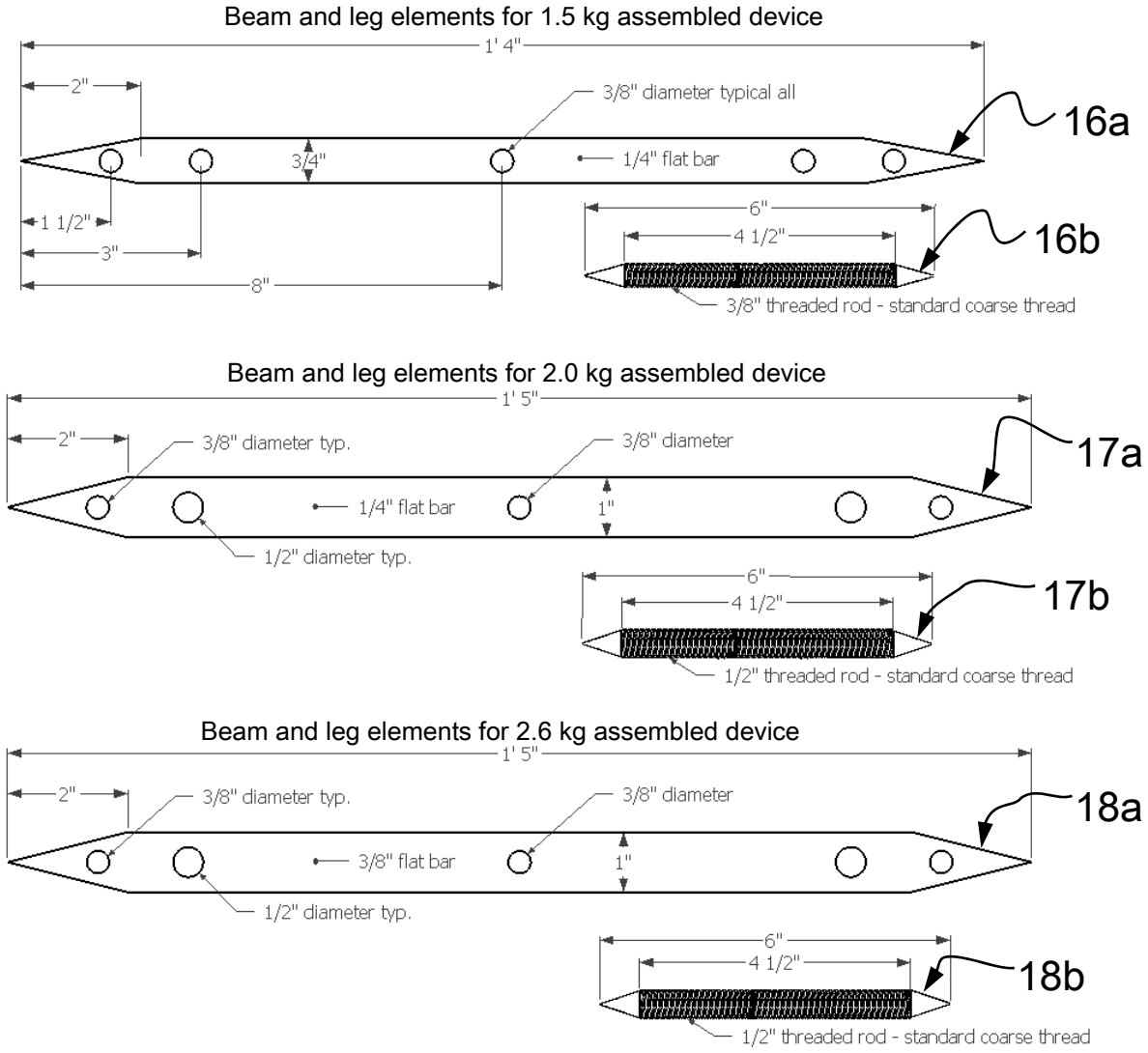
Oblique view

Fig. 4



Conceptual view as deployed

Fig. 5


Beam and leg elements for 1.5 kg assembled device
1' 4"
2"
3/8" diameter typical all
16a
3/4"
1/4" flat bar
1 1/2"
3"
8"
6"
4 1/2"
16b
3/8" threaded rod - standard coarse thread
Beam and leg elements for 2.0 kg assembled device
1' 5"
2"
3/8" diameter typ.
3/8" diameter
17a
1/4" flat bar
1"
1/2" diameter typ.
6"
4 1/2"
17b
1/2" threaded rod - standard coarse thread
Beam and leg elements for 2.6 kg assembled device
1' 5"
2"
3/8" diameter typ.
3/8" diameter
18a
3/8" flat bar
1"
1/2" diameter typ.
6"
4 1/2"
18b
1/2" threaded rod - standard coarse thread