

(19)



(11)

EP 2 119 998 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.11.2009 Bulletin 2009/47

(51) Int Cl.:
F41B 3/02 (2006.01) **F41F 3/045** (2006.01)

(21) Application number: **08275016.7**

(22) Date of filing: **13.05.2008**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**
Designated Extension States:
AL BA MK RS

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(54) **Launch system**

(57) The present invention relates to a launch system for air vehicles. More specifically, the present invention relates to launching unmanned air vehicles (UAVs) (20) that are unable to be launched by hand. The present

invention provides an apparatus for launching a winged vehicle, comprising: a projectile launching means (50); and means (40) for converting projectile momentum into acceleration of a winged vehicle.

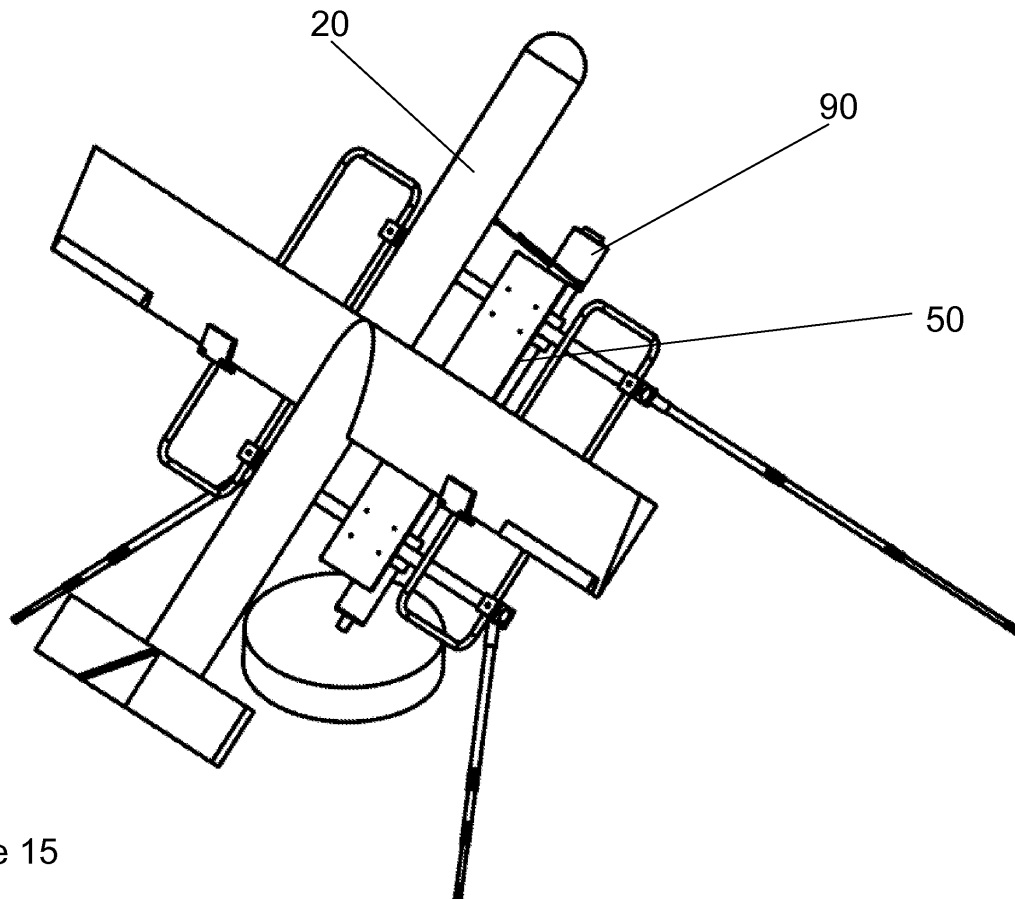


Figure 15

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Description

[0001] The present invention relates to a launch system for air vehicles. More specifically, the present invention relates to launching unmanned air vehicles (UAVs) that are unable to be launched by hand.

[0002] At present, there exist lightweight UAVs that weigh around 10kg and which can be hand-launched by simply picking them up and throwing them. Realistically, it is only possible for vehicles significantly lighter than 10kg to be hand-launched. If, however, the UAV is heavier than 10kg, it becomes much more difficult to launch the device. These vehicles can be powered by a range of means, such as a petrol engine or electric motor.

[0003] Currently, heavier UAVs are launched in the field using a catapult device, but these catapults are cumbersome and generally unsuitable for use in fast moving combat situations. Firstly, the catapult may need to be carried by a single person, as they are about 20ft long, thus will be cumbersome to carry around. Secondly, the catapults are slow to set up due to their size, dimensions and weight.

[0004] Still heavier UAVs are provided with undercarriage to enable them to take-off and land on runways or landing strips, but this technical solution is generally reserved for more capable vehicles. Lower cost vehicles must do without undercarriage and so an alternative launch means is required.

[0005] Accordingly, the present invention provides an apparatus for launching an unmanned air vehicle, comprising a mortar launcher, a mounting means for mounting an unmanned air vehicle on said mortar launcher; a cap comprising a mating surface suitable for mating with the head of a mortar round; wherein the cap is connected with a bungee rope to an unmanned air vehicle.

[0006] An advantage of the present invention is that mortars are eminently portable and are readily available in most armed forces, so the invention allows a launch system compatible with equipment readily available already.

[0007] Specific embodiments of the invention will now be described, by way of example only and with reference to the accompanying drawings that have like reference numerals, wherein:

Figure 1 is a cross-sectional diagram of an apparatus according to an embodiment of the present invention;

Figure 2 is a cross-sectional diagram of an apparatus according to an embodiment of the present invention showing the first step of operation;

Figure 3 is a cross-sectional diagram of an apparatus according to an embodiment of the present invention showing the second step of operation;

Figure 4 is a cross-sectional diagram of an apparatus

according to an embodiment of the present invention showing the third step of operation;

Figure 5 is a cross-sectional diagram of an apparatus according to an embodiment of the present invention showing the fourth step of operation;

Figure 6 is a diagram of an apparatus according to an embodiment of the present invention showing the fifth step of operation;

Figure 7 is a diagram of an apparatus according to an embodiment of the present invention showing the final step of operation;

Figure 8 is a diagram of a cap according to a preferred embodiment of the present invention;

Figure 9 is a diagram of the cap of Figure 8 from a different perspective with a section line A-A;

Figure 10 is a cross-sectional diagram of the cap of Figure 8 along the section line A-A of Figure 9;

Figure 11 is a perspective view of a cap of Figure 8 connected to two metal wires, to which bungee ropes can be connected at the free ends of the wires;

Figure 12 is a diagram of a UAV mounted on a support frame over a mortar launcher according to a preferred embodiment of the invention;

Figure 13 is a diagram of a UAV mounted on a support frame over a mortar launcher according to a preferred embodiment of the invention;

Figure 14 is a diagram of a UAV mounted on a support frame over a mortar launcher according to a preferred embodiment of the invention;

Figure 15 is a diagram of a UAV mounted on a support frame over a mortar launcher according to a preferred embodiment of the invention;

Figure 16 is a diagram of the support frame of Figures 12 to 15 according to a preferred embodiment of the invention;

Figure 17 is a diagram of the support frame of Figures 12 to 15 according to a preferred embodiment of the invention;

Figure 18 is a diagram of the support frame of Figures 12 to 15 according to a preferred embodiment of the invention;

Figure 19 is a diagram of the support frame of Figures 12 to 15 according to a preferred embodiment of the

invention;

Figure 20 is a side view diagram of the wing support of the support frame of Figures 15 to 18 according to a preferred embodiment of the invention;

Figure 21 is a perspective view diagram of the wing support of the support frame of Figures 15 to 18 according to a preferred embodiment of the invention;

Figure 22 is a diagram of a telescopic leg of the support frame according to a preferred embodiment of the invention;

Figure 23 is a diagram of a folding side of the support frame according to a preferred embodiment of the invention;

Figure 24 is a diagram of one of the mortar mounting blocks of the support frame according to a preferred embodiment of the invention;

Figure 25 is a cross-sectional diagram of the nose portion of a fin-stabilised mortar shell, showing the notches used to mate the mortar shell to a slipper plate;

Figure 26 is a perspective view of a slipper plate as used to mate with the notches in a nose portion of a fin-stabilised mortar shell of Figure 25;

Figure 27 is a perspective view of a fin-stabilised mortar when mated with the cap of Figures 8 to 10;

Figure 28 is a diagram of a UAV with a hook mounted under the nose portion for attaching to a bungee rope;

Figure 29 is a diagram of the hook of Figure 28, also showing a ring to which a bungee rope would be attached;

Figure 30 is a diagram of a butterfly support arrangement according to an alternative embodiment of the invention; and

Figure 31 is a diagram of the butterfly support arrangement of Figure 30 mounted on a mortar launcher.

[0008] The general principles of the invention will now be described with reference to Figures 1 to 7:

Referring first to Figure 1, there is shown a UAV 20 mounted on a mortar launcher in a pre-launch arrangement.

[0009] The base 10 of the mortar launcher, to which

one end, the fixed end, of the mortar launcher tube 50 is hingedly fixed, is put in position on the ground at the desired launch site. The fixed end is a closed end of the mortar tube 50. The mortar launcher tube's other end, the free end, is supported by a stand 60 that rests on the ground and thus supports the end of the tube 50. The free end of the mortar tube 50 is open, allowing a fin-stabilised mortar 80 to be inserted into the tube 50 and to exit the tube 50 when launched.

[0010] The UAV 20 is mounted on takeoff runners 30 that are formed on top of the mortar launcher tube 50 in this embodiment, using a custom latch 100 to only release the UAV 20 when it is moving in the correct direction. It should be noted that alternative arrangements are possible for how the UAV 20 is mounted on the mortar launcher tube 50 and these are discussed below.

[0011] The engine of the UAV 20 is started at this point, so that when the launch is complete it can continue flying, while the mortar round 80 will drop to the ground.

[0012] A mortar round 80 is placed in the free end of the mortar launcher tube 50 and held in place by a standard issue slipper plate 110. The slipper plate 110 is connected to a pull chord 70 with a pin. A cap 90 is placed over the free end, or muzzle, of the mortar launcher tube 50 and the slipper plate 110. One end of a bungee rope 40 is attached to the cap 90. The other end of the bungee rope 40 is attached to a hook 120 underneath the nose of the UAV 20.

[0013] The slipper plate 110 is shown in more detail in Figure 26 and can hold a mortar round 80 in place near the muzzle of the mortar launcher tube 50 because each mortar round 80 has two grooves 130, shown in Figure 25, near the nose end of the mortar round 80 into which the edges of the slipper plate 110 insert, preventing the mortar round 80 moving further into the mortar launcher tube 50 as the slipper plate 110 is larger than the muzzle diameter of the mortar launcher tube 50.

[0014] Referring now to Figure 2, there is shown the apparatus of Figure 1 but now during the first step of operation. The safety chord 70 is pulled by the operator, pulling the slipper plate 110 out of the grooves 130 that hold the mortar round 80 in place at the muzzle of the tube 50, causing the mortar round 80 to drop down the mortar launch tube 50 to the bottom of the mortar launch tube 50 from the top of the mortar launch tube 50.

[0015] Referring now to Figure 3, there is shown the apparatus of Figure 1 during the second step of operation. The firing pin of the mortar charge 80 is triggered when it hits the bottom of the mortar launch tube 50, initiating the propellant and thus the mortar round 80 rapidly accelerates up the mortar launch tube 50.

[0016] Referring now to Figure 4, there is shown the apparatus of Figure 1 during the third step of operation. The mortar round 80 hits the cap 90, mating with a contacting face 140 of the cap 90, which is designed to mate with the nose of the mortar round 80. Several alternative caps are possible, and some are described below.

[0017] Referring now to Figure 5, there is shown the

apparatus of Figure 1 during the fourth step of operation. The mortar round 80 continues out of the mortar launch tube 50 along with the cap 90, the mortar round 80 having mated with the cap 90. As cap 90 is also connected to one end of the bungee rope 40, the other end of the bungee rope 40 being fixed to the nose of the UAV 20, the bungee rope 40 absorbs the initial shock of the mortar launch and starts to stretch between the stationary UAV 20 and the moving mortar round 80. Once the tension in the bungee rope 40 is sufficient, the bungee rope 40 starts to pull the UAV 20 in the direction of travel of the mortar 80 and cap 90, causing it to gradually accelerate rather than accelerating at the same high acceleration as the mortar round 80.

[0018] Referring now to Figure 6, there is shown the apparatus of Figure 1 during the fifth step of operation. Here, the bungee rope 40 has been extended as far as the respective forces will allow it, so the custom latch 100 releases UAV 20 as enough force is pulling the UAV 20 to allow it to take off and the UAV 20 leaves the takeoff runners 30 with a suitably high acceleration to take off but not with too high an acceleration to cause damage to the UAV 20.

[0019] It should be noted that no custom latch 100 is needed, but some mechanism is needed to hold the UAV 20 in place when it is mounted over the mortar launcher tube 50 whilst allowing it to accelerate in the direction of the mortar 80 when launched. A preferred embodiment with such a solution is detailed below.

[0020] Referring now to Figure 7, there is shown the apparatus of Figure 1 during the final step of operation. Here, the UAV 20 is travelling under its own propulsion as it is airborne and at a suitable speed to continue flying, while the mortar shell is losing momentum, so the UAV overtakes the mortar 80 and cap 90, causing the bungee rope 40 to come loose around 0.5 seconds after firing the mortar. The bungee rope 40, cap 90 and mortar shell 80 fall to the earth. The hook 120 to which the bungee rope 40 is connected only allows the mortar round 80 to pull the UAV 20, but not to cause drag as once the mortar is no longer pulling the UAV 20 forwards, the ring 150 to which the bungee rope is connected (see Figures 28 and 29).

[0021] Now, the preferred embodiment of the invention will be described:

In Figures 8, 9 and 10 the preferred embodiment of the cap 90 is shown in more detail: the cap 90 is formed as a cylinder and has a hollow interior. The cap 90 has an opening 160 at the top and an opening 170 at the bottom. There are two holes 180 formed opposite each other in the sides of the cap 90 near the bottom opening 170 to allow the two bungee ropes 40 to be mounted, and these holes 180 are countersunk on the inside face of the cap 90 to prevent the bolts, which hold the bungee ropes 40 to the cap, obstructing the path of the mortar round 80.

[0022] In the preferred embodiment, two bungee ropes 40 are used and these are mounted on opposite sides of the cap 90 to stabilise the trajectory of the mortar once it mates with the cap 90, and this also prevents the cap 90 rotating in flight. The inside, contacting, face 140 of the cap 90 decreases in diameter from one open end 170 to the other open end 160, so that the mortar round 80 mates with the cap 90 when it is launched as it becomes lodged in the cap 90 when the diameter of the cap 90 decreases to the substantially the diameter of the widest diameter of the mortar shell 80.

[0023] In the preferred embodiment, as shown in Figure 11, the bungee ropes are not attached directly to the holes using bolts, as the fin of the mortar round can wear away the bungee ropes 40. Instead, metal rods or wire 190 are bolted to the holes 180 in cap 90 and the bungee ropes are connected to the ends of these rods/wires 190.

[0024] Figure 27 shows a fin-stabilised mortar 80 as would be suitable for use with the invention once mated with the cap 90.

[0025] Figures 16, 17, 18, 19, 20, 21, 22, 23 and 24 show a preferred mounting means that would replace the take-off runners 30 with a stand-alone frame 200 that is positioned above the mortar launcher 50. The frame 200 can be folded to allow it to fit into restricted spaces. The frame 200 is mounted on four telescopic legs 210 (shown in more detail in Figure 22), to allow for it to be set up on substantially non-flat surfaces. It has two folding sides 220 (shown in more detail in Figure 23) that are folded out in a C shape to provide the largest clearance for a UAV 20 mounted on top of the mortar launcher 50, in order to give maximum clearance for any rear-mounted propellers. Each folding side 220 has a wing-shaped wedge 230 (shown in more detail in Figures 20 and 21) mounted roughly centrally that mates with the rear of the each wing of the UAV 20 such that the UAV 20 is supported by its wings on the folding sides and prevented from sliding backwards down the folding sides 220 by the wing-shaped wedges 230 mating with the rear of each wing. Figures 12 to 15 show the frame 200 when arranged over a mortar launcher 50 and with a UAV 20 in place.

[0026] Finally, alternatives embodiments of the invention will be described:

Figures 30 and 31 show an alternative mounting means that would replace the take-off runners 30 with a butterfly launch platform 250. This is formed from two substantially flat rectangular sheets that are hinged along their longer sides and where the hinged portion is mounted on the mortar tube 50 as shown in Figure 31. The two rectangular sheets are angled relative to each other, the free edges of each sheet thus forming a support for the wings of a UAV 20. It is anticipated that the butterfly launch platform 30a can be made as a fixed, unhinged, arrangement or a curved arrangement but a hinged arrangement is preferred over these other arrangements as the ap-

paratus can then be disassembled and folded up if it is hinged.

[0027] It should be noted that the invention could be used to launch both air, underwater and sea vehicles from ships.

[0028] Other forms of cap 90 are conceived, the essential features being a mating surface for the mortar shell 80 and some means by which to connect the bungee rope 40.

[0029] The bungee rope 40 could be replaced with other means, such as a spring.

[0030] It should also be noted that starting the propulsion means of the UAV 20 before launching it using the method of the invention reduces the force needed to launch the UAV 20, and thus also increases the weight of UAV 20 that it is possible to launch using this method. It is also possible, however, to use this method to launch a UAV 20 without having the propulsion means on until the UAV 20 is in the air.

[0031] Another means for connecting the bungee rope 40 to the UAV 20 is by use of a glider release latch instead of a hook. Other means are envisaged, including an electronic release mechanism triggered by either a time or by force measurements, but the essential feature is that the release occurs before or at the point when the mortar ceases to pull the UAV 20 forwards and instead acts as drag.

[0032] It is to be understood that any feature described in relation to any one embodiment may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the embodiments, or any combination of any other of the embodiments. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

Claims

1. An apparatus for launching a winged vehicle, comprising:

a projectile launching means;
means for converting projectile momentum into acceleration of a winged vehicle.

2. An apparatus according to claim 1, wherein the winged vehicle is an air vehicle.

3. An apparatus according to claim 1, wherein the winged vehicle is an unmanned air vehicle.

4. An apparatus according to any preceding claim, wherein the projectile launching means comprises a mortar launcher.

5. An apparatus according to any preceding claim, wherein the means for converting projectile momentum into acceleration of a winged vehicle comprises a projectile, a cap comprising a mating surface suitable for mating with the head of a projectile round and a biased resilient means, and wherein the cap is connected with a bungee rope to an unmanned air vehicle.

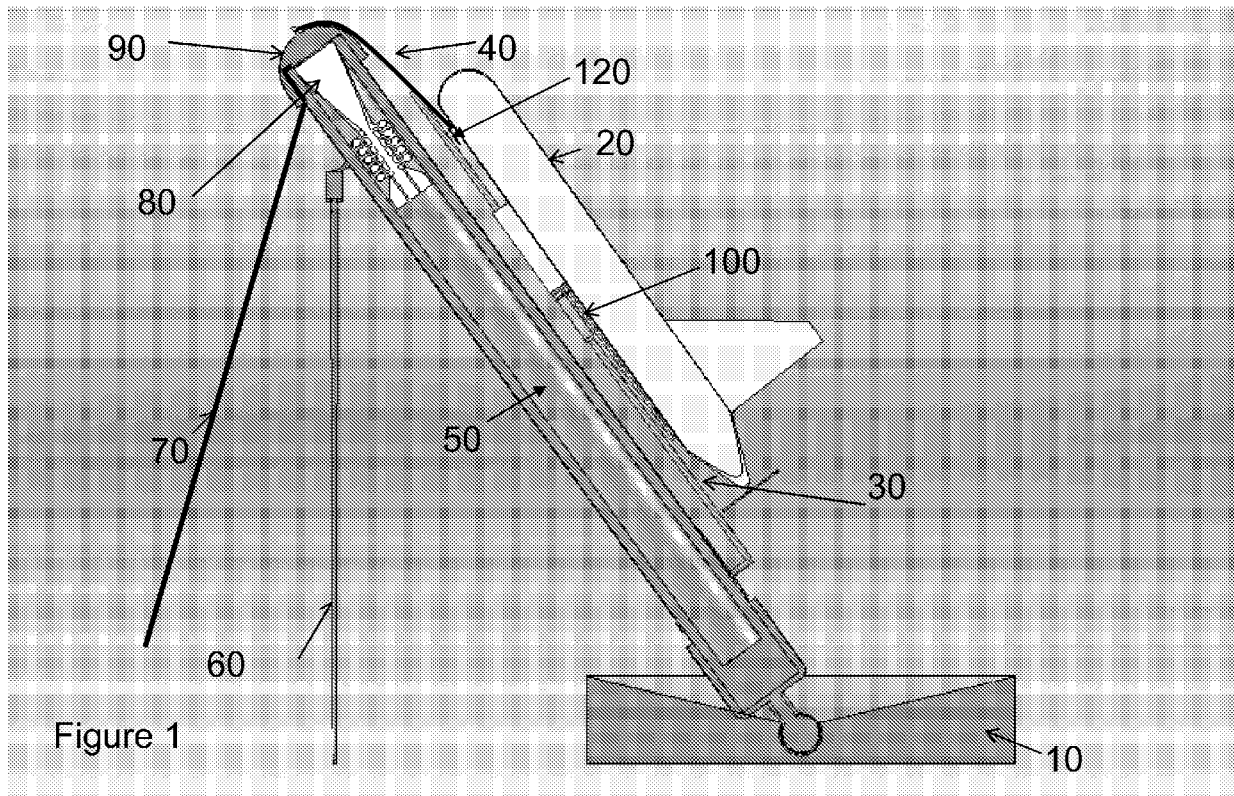
6. An apparatus according to claim 5 wherein the biased resilient means can elongate.

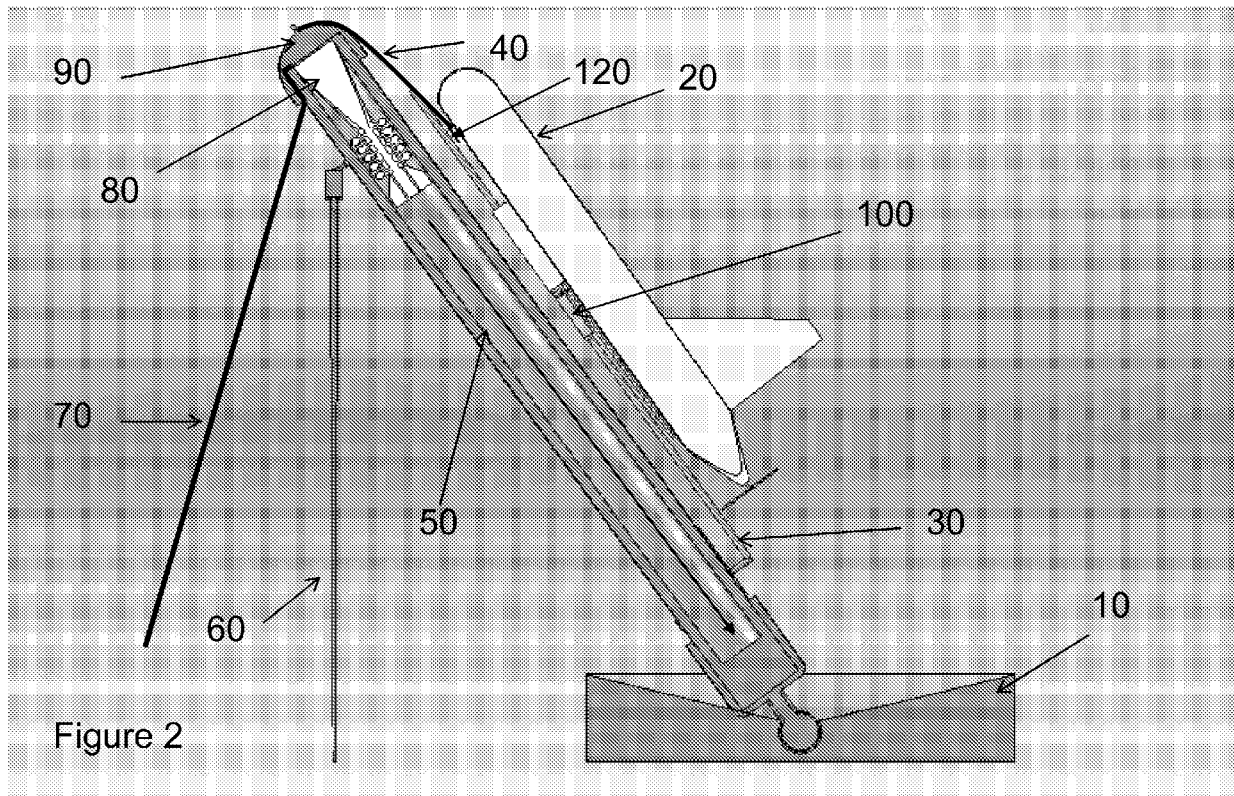
7. An apparatus according to claim 5 wherein the biased resilient comprises a bungee rope.

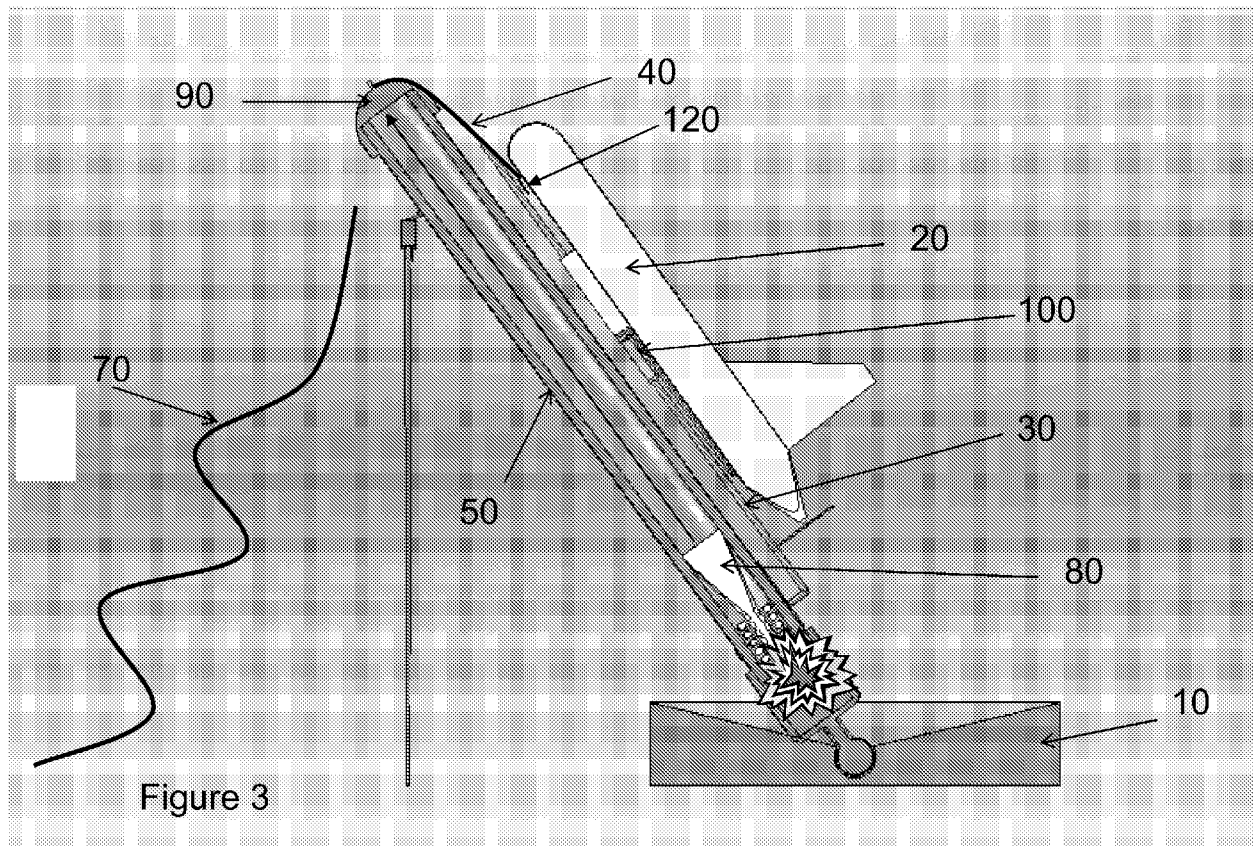
8. An apparatus according to claim 5 wherein the biased resilient comprises a spring.

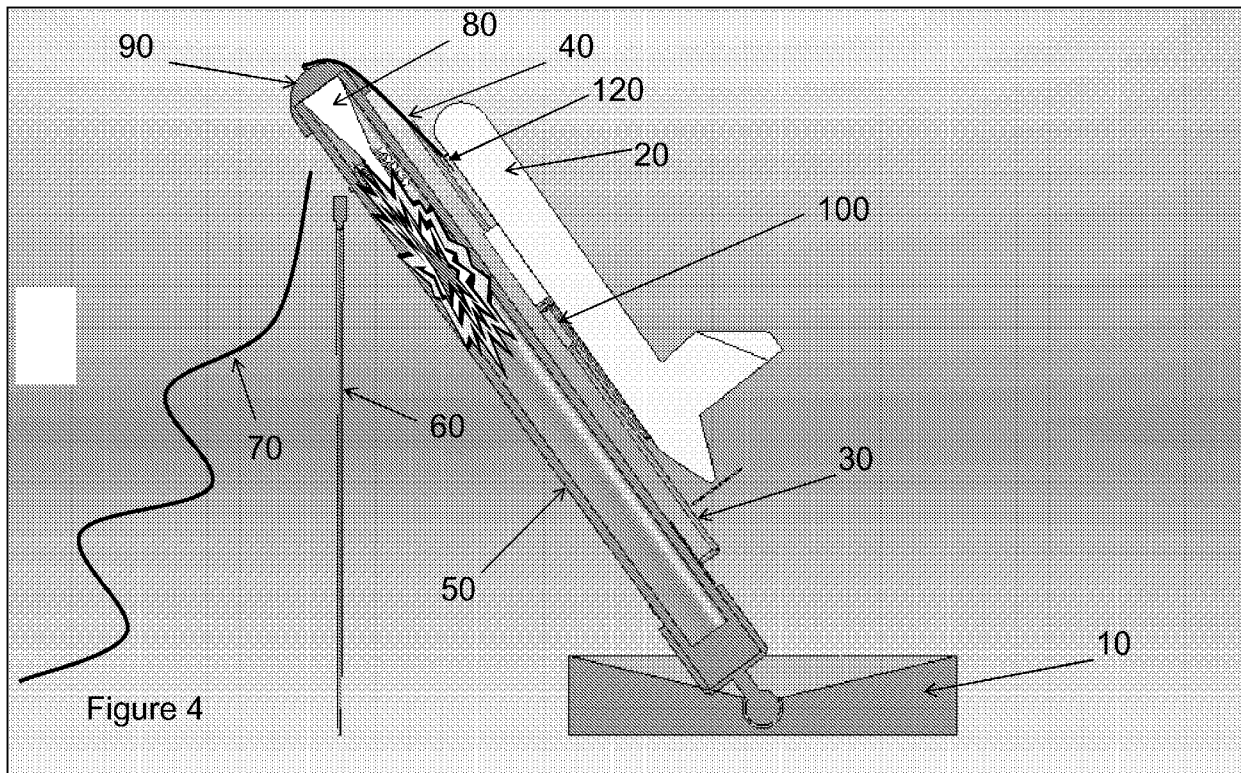
9. An apparatus according to claim 5 wherein the projectile is a mortar round.

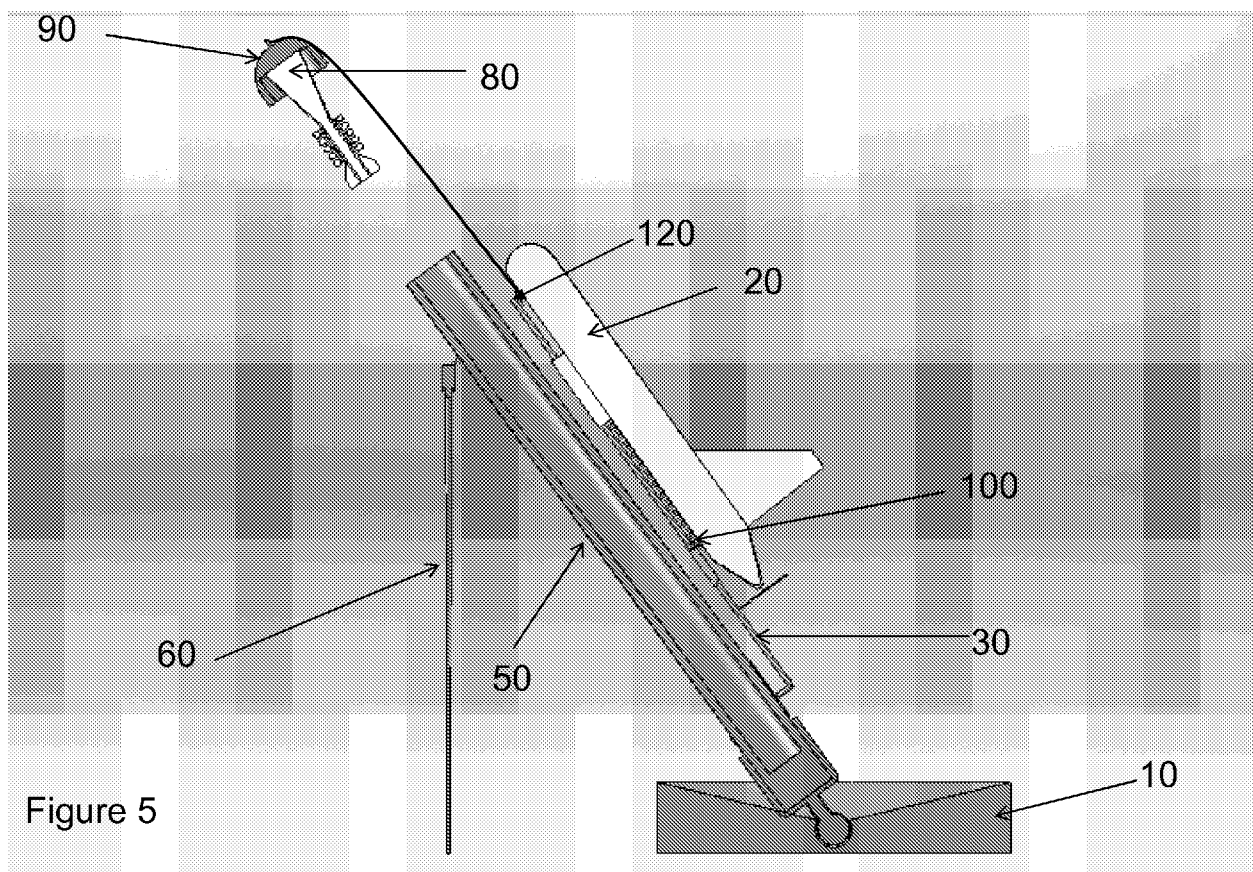
10. An apparatus according to any preceding claim, wherein the winged vehicle is mounted on a frame positioned above the projectile launching means.

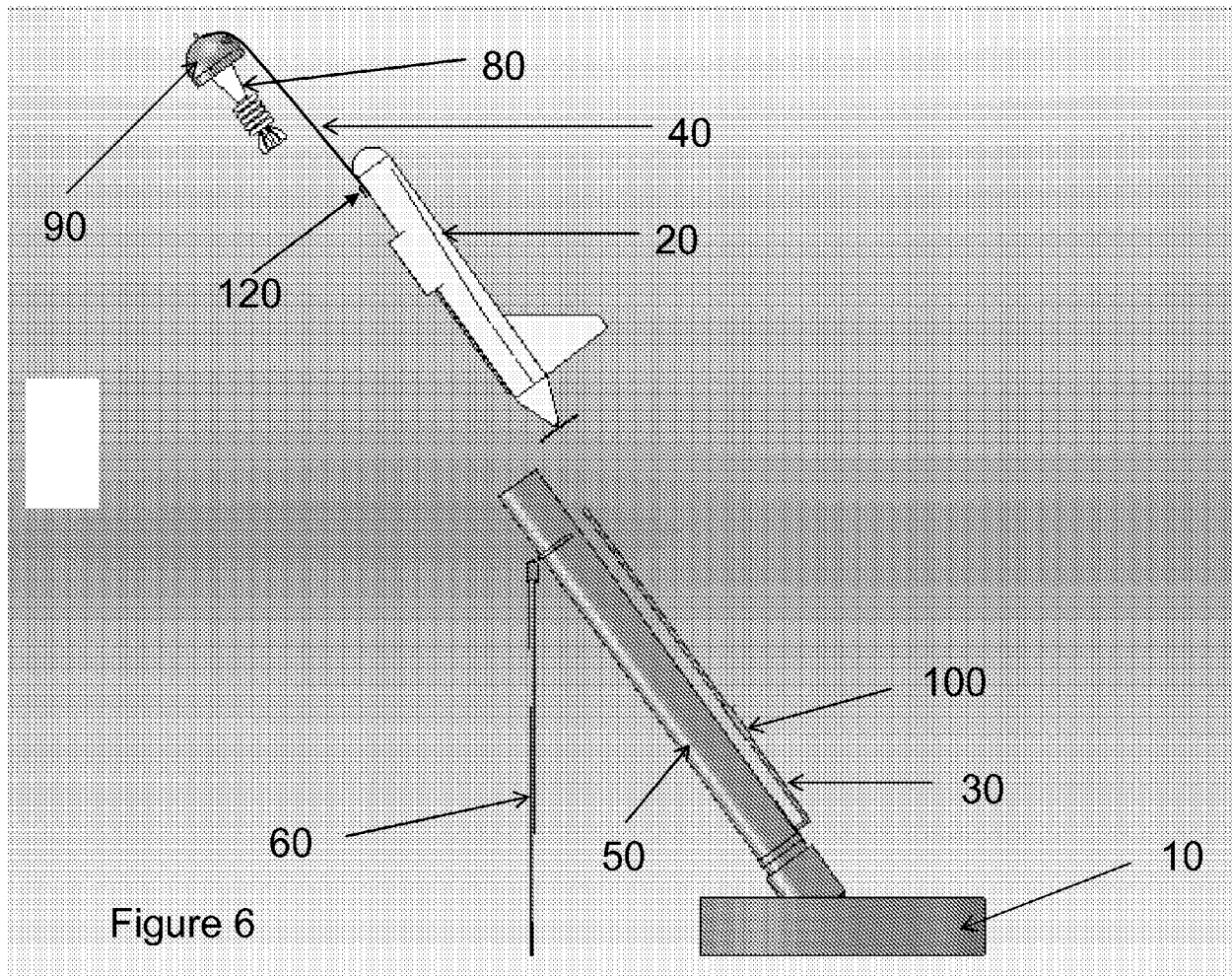


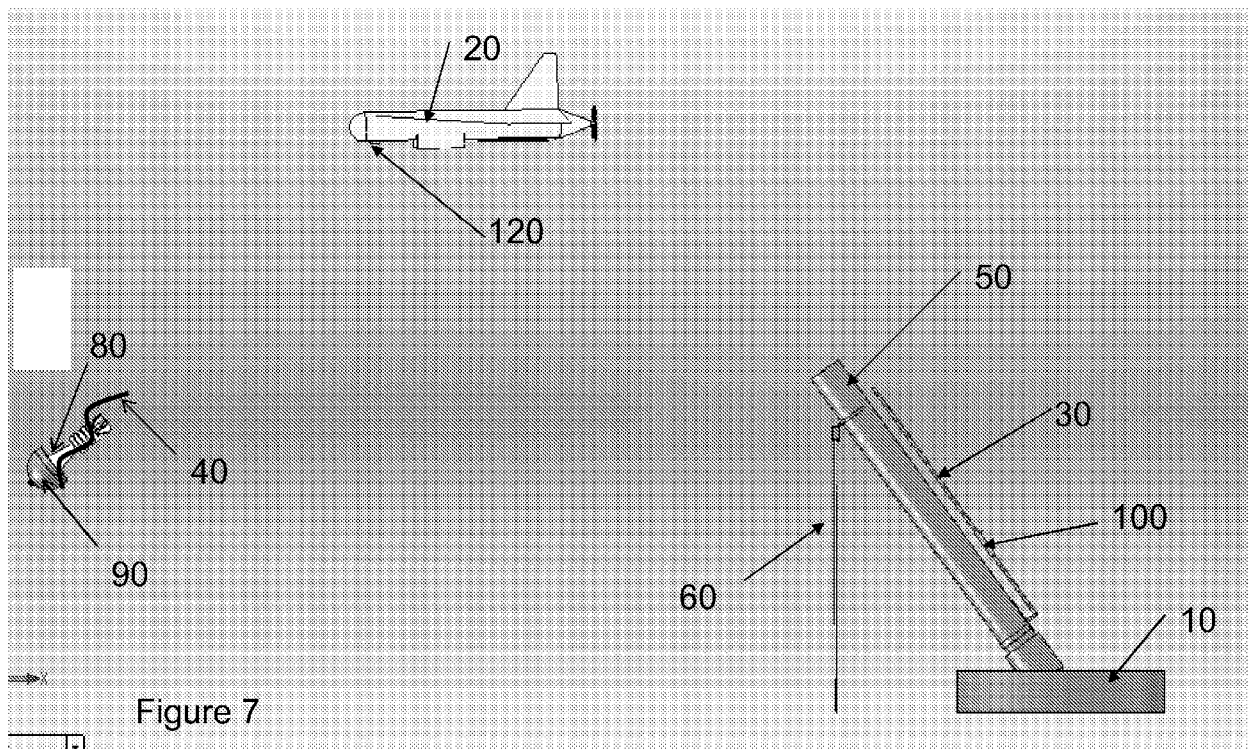


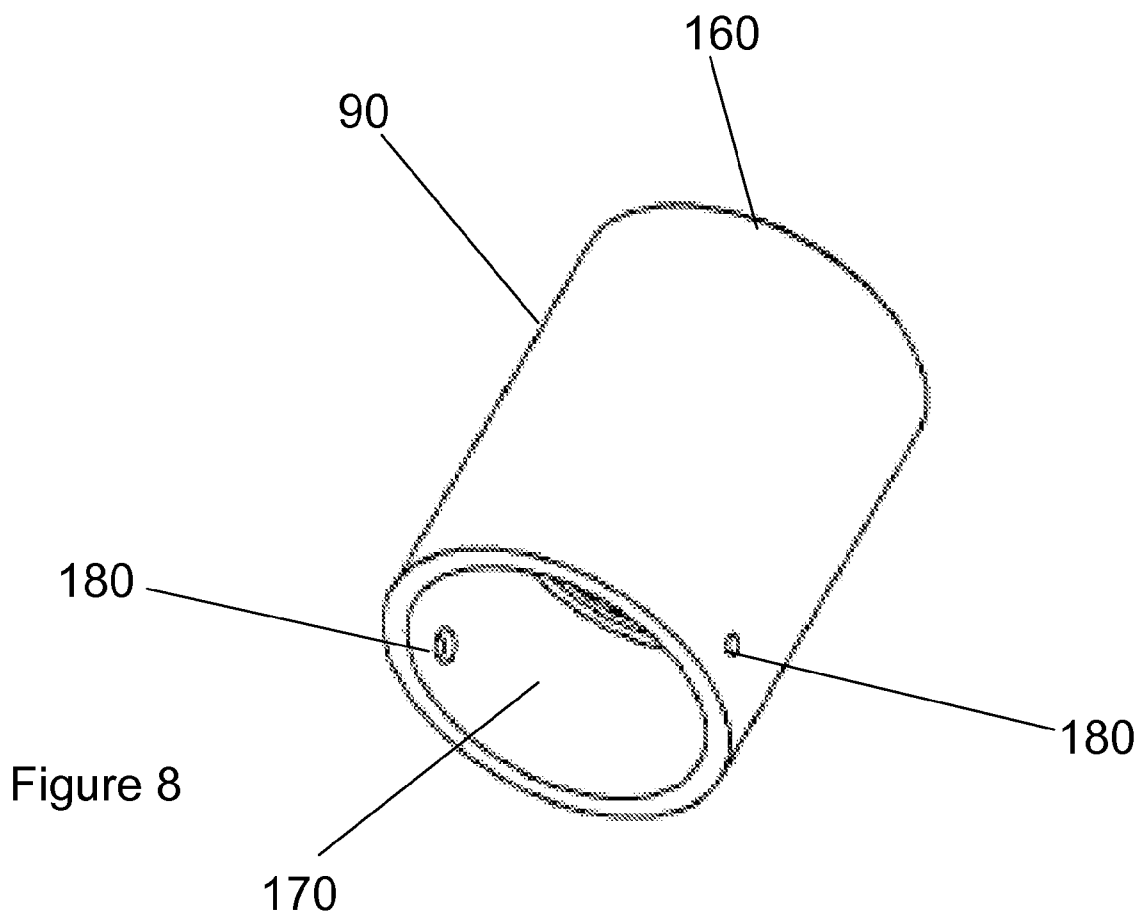












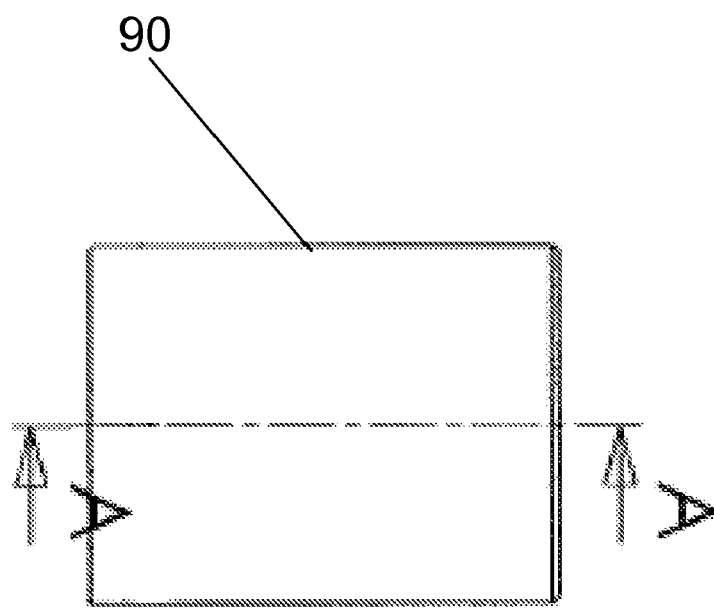


Figure 9

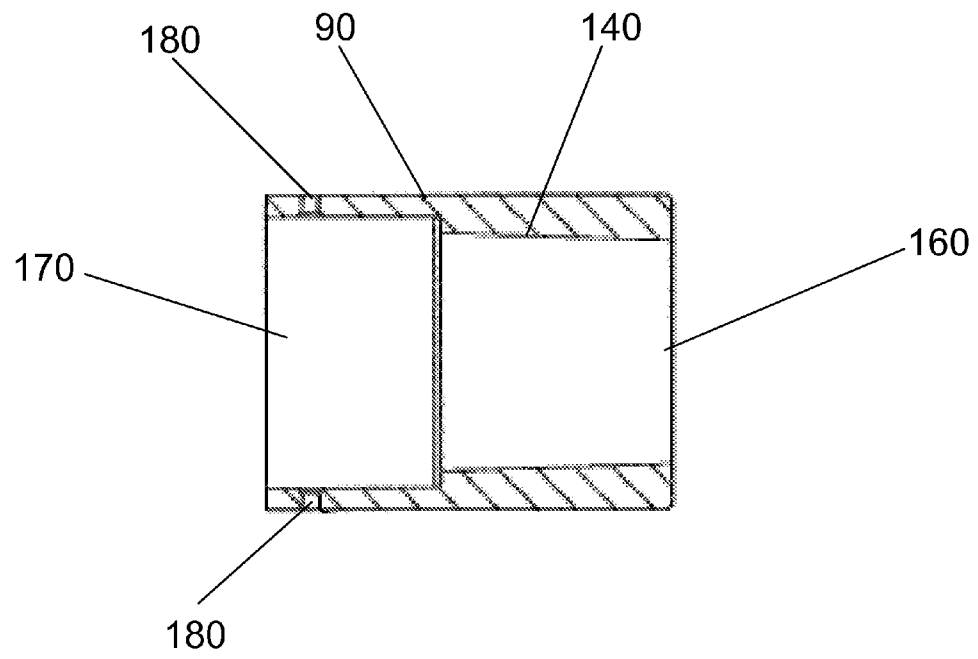


Figure 10

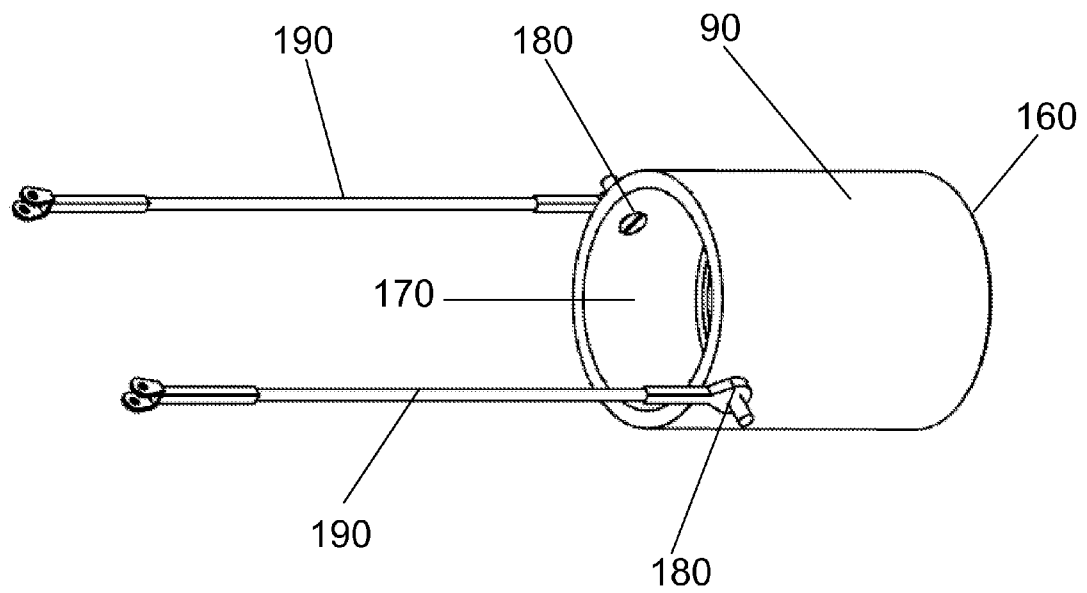


Figure 11

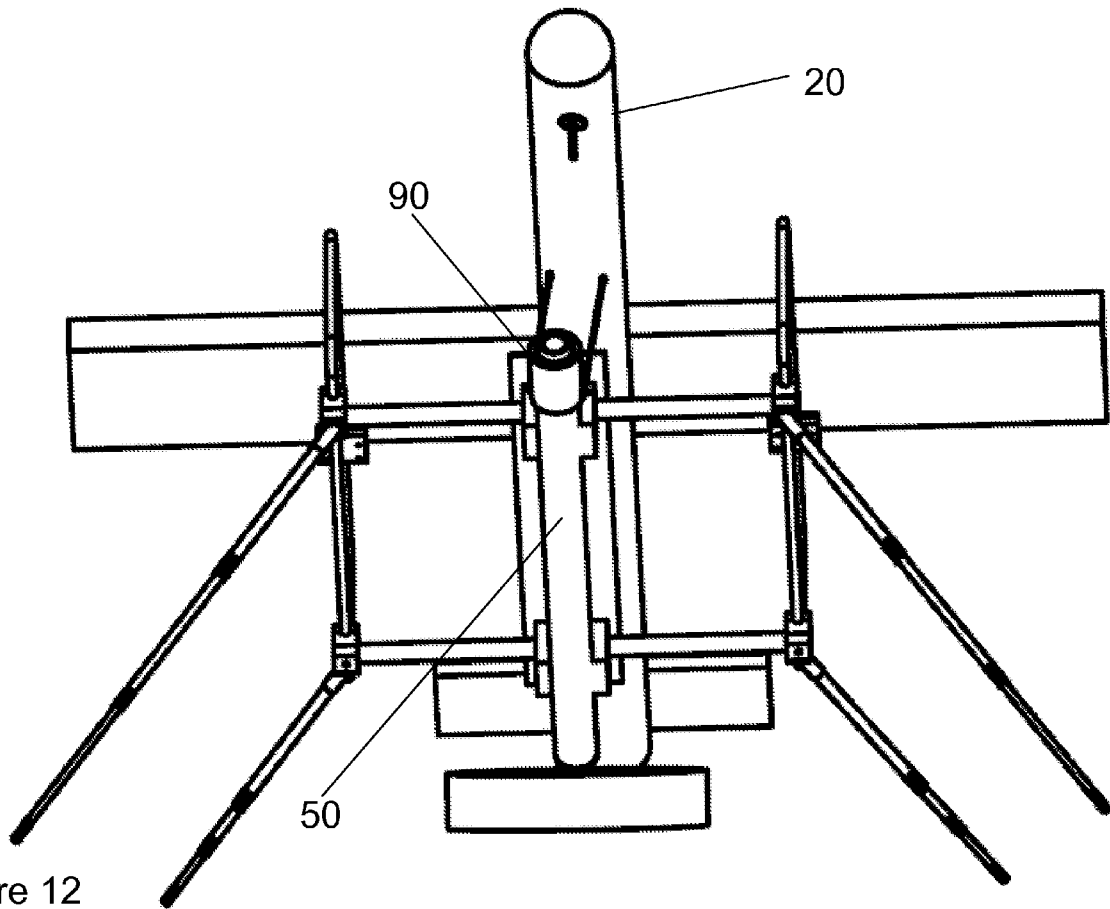


Figure 12

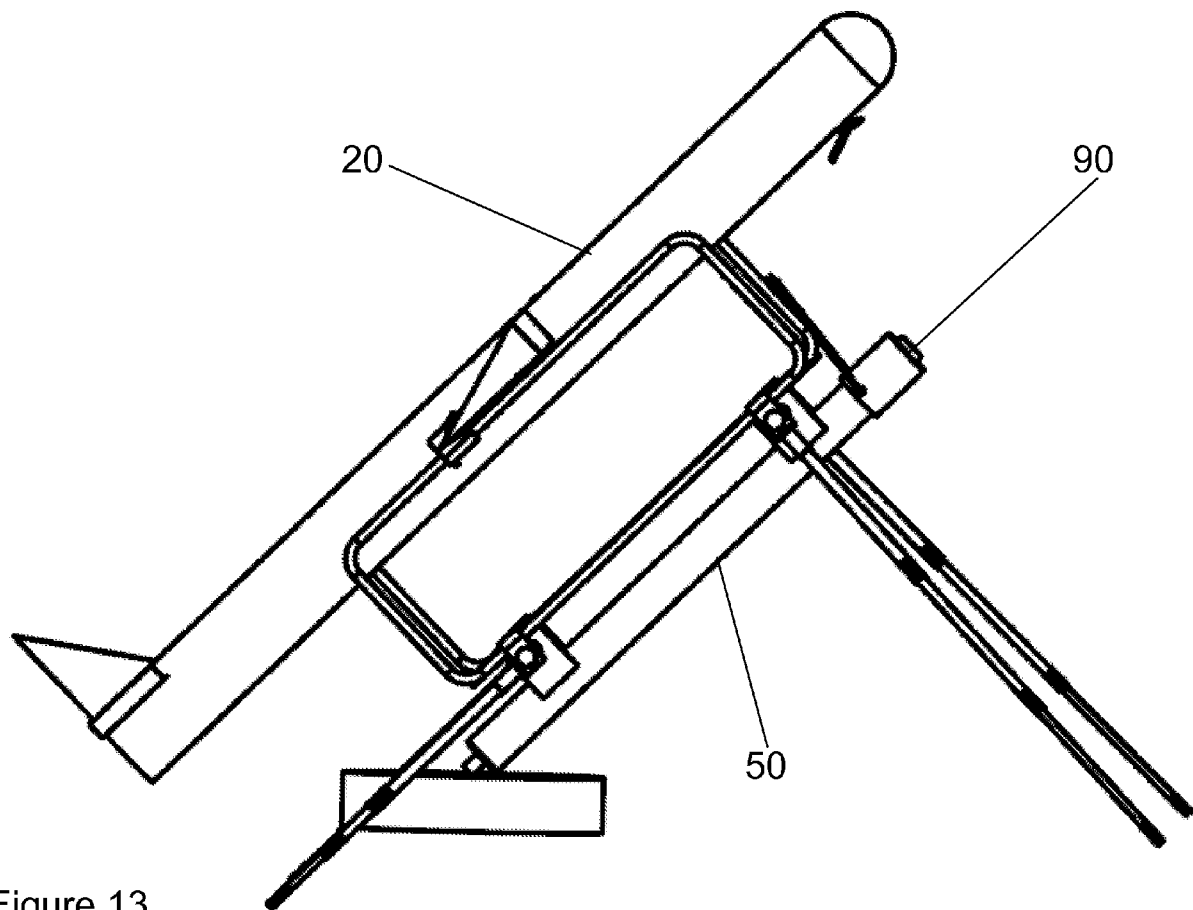


Figure 13

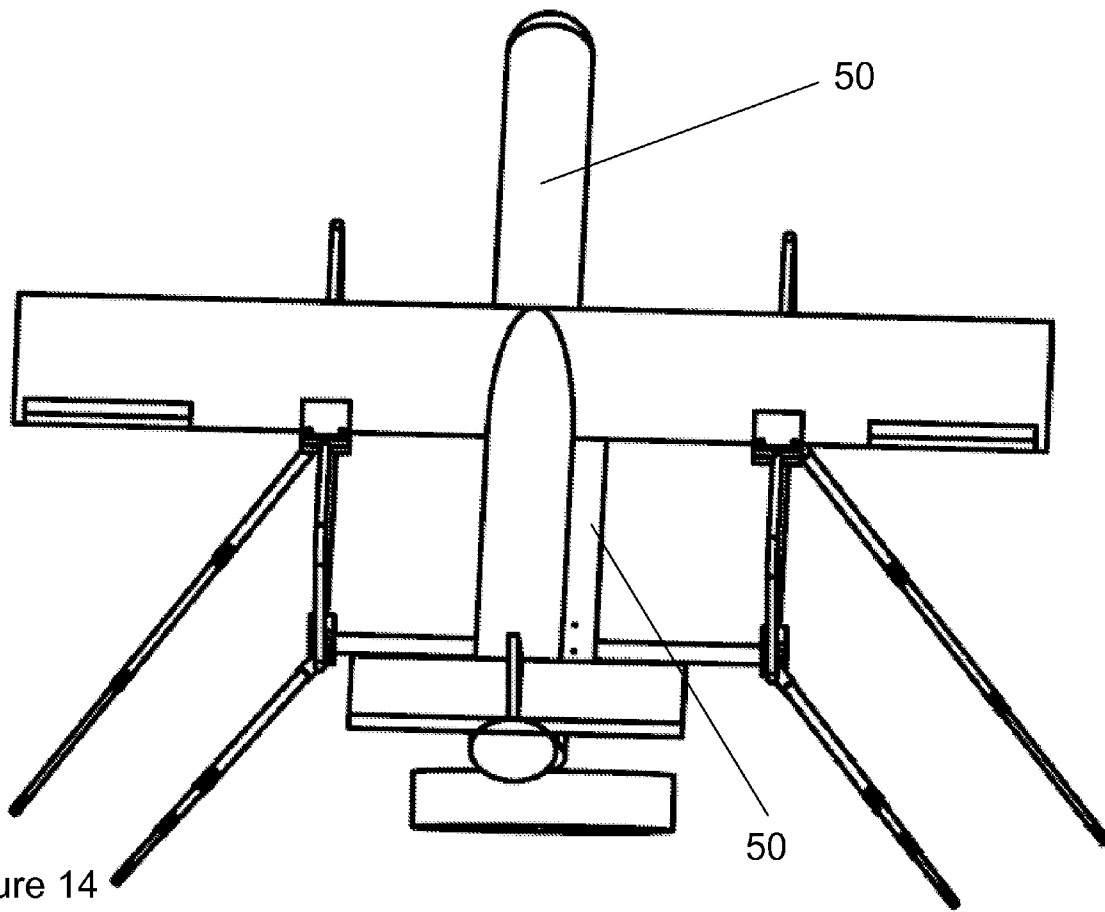


Figure 14

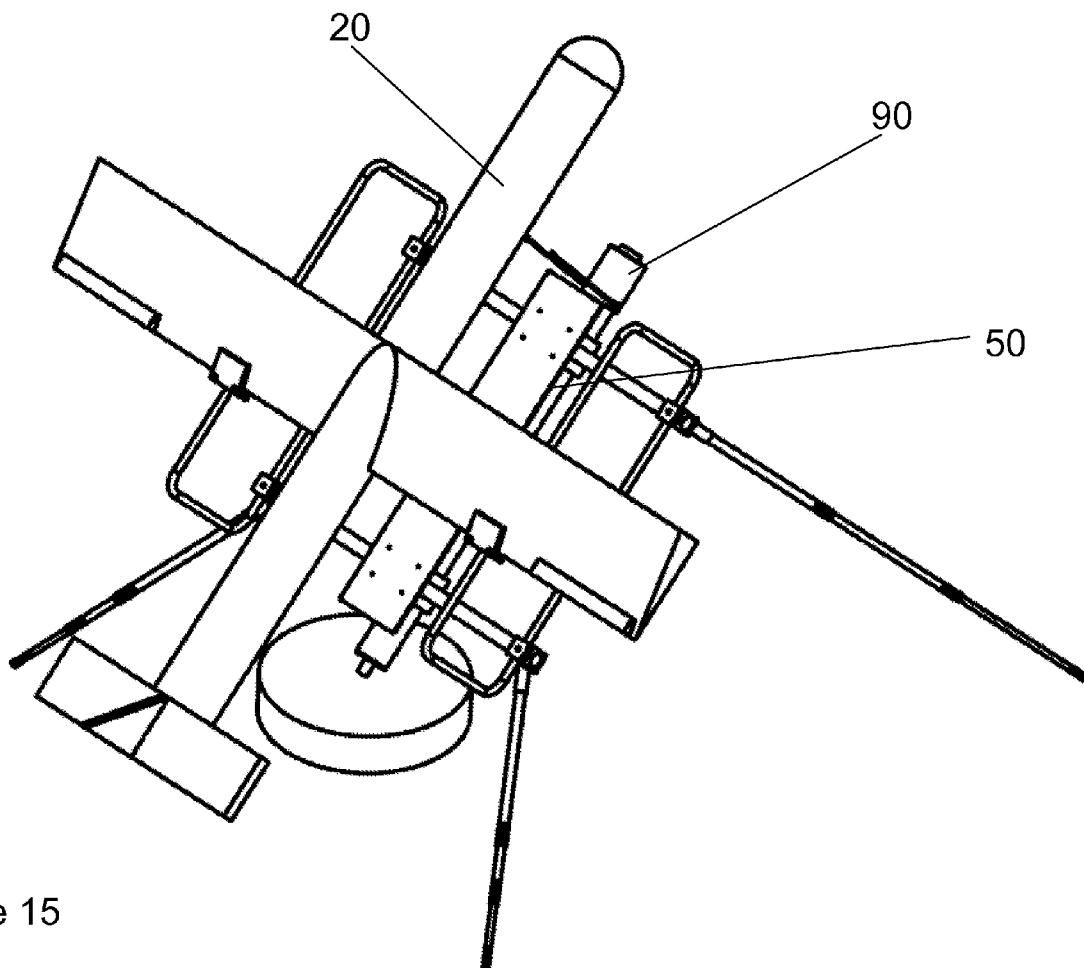


Figure 15

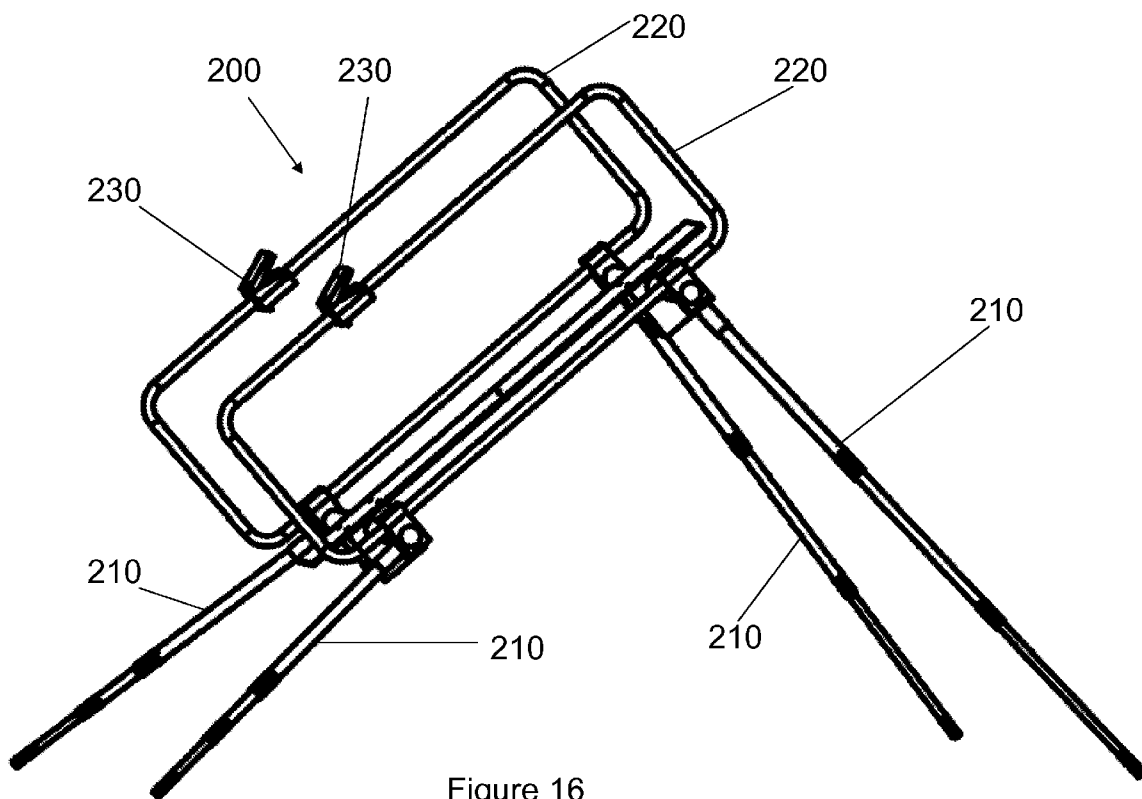


Figure 16

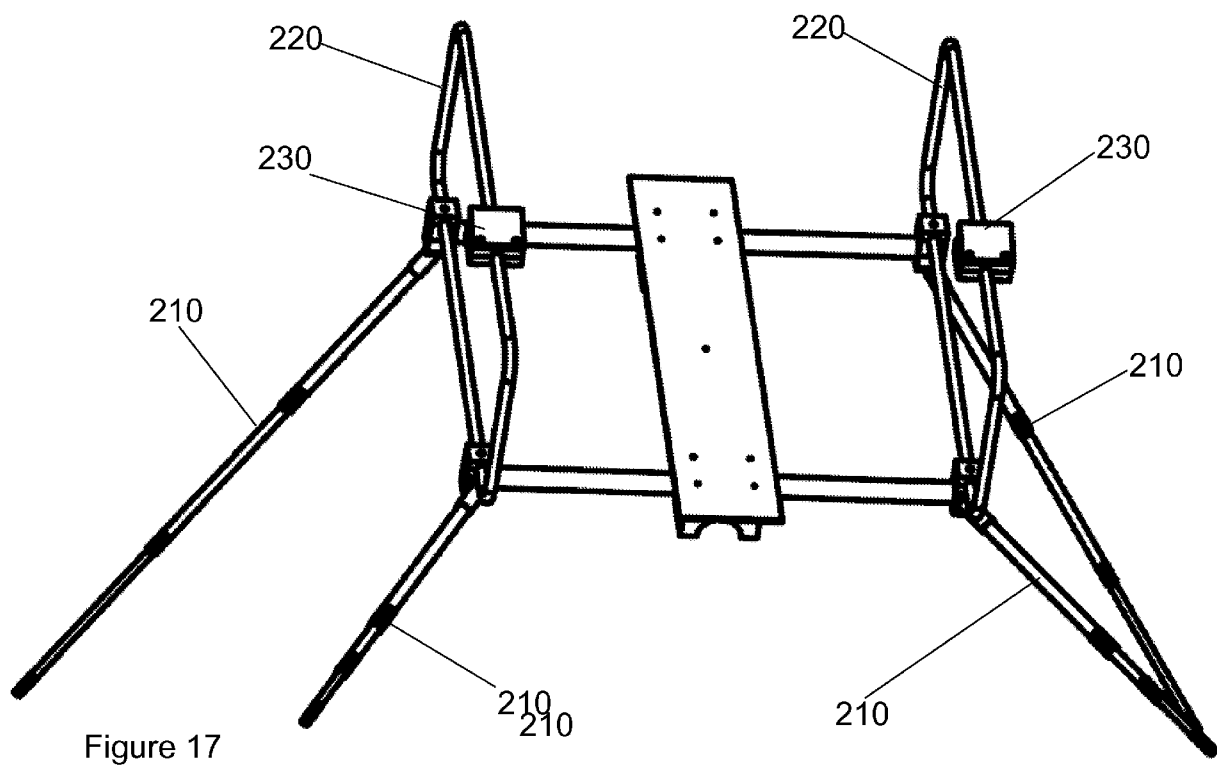


Figure 17

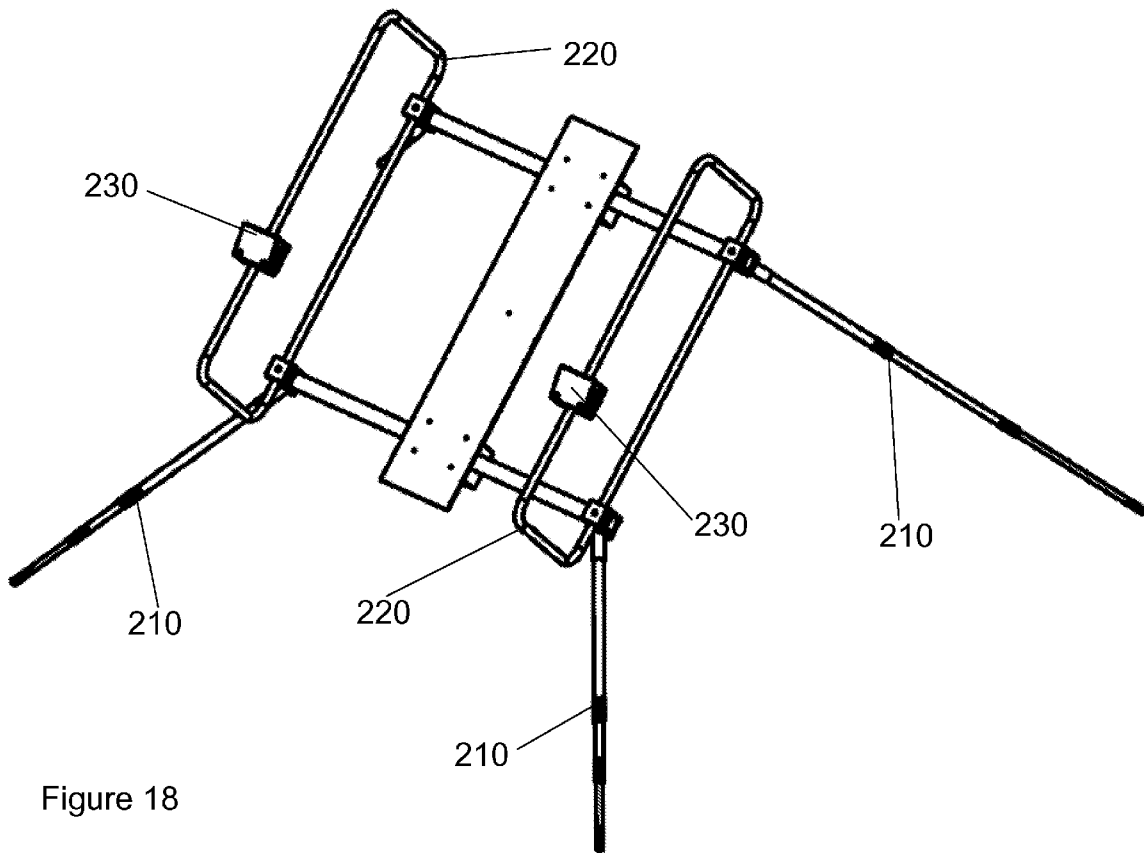


Figure 18

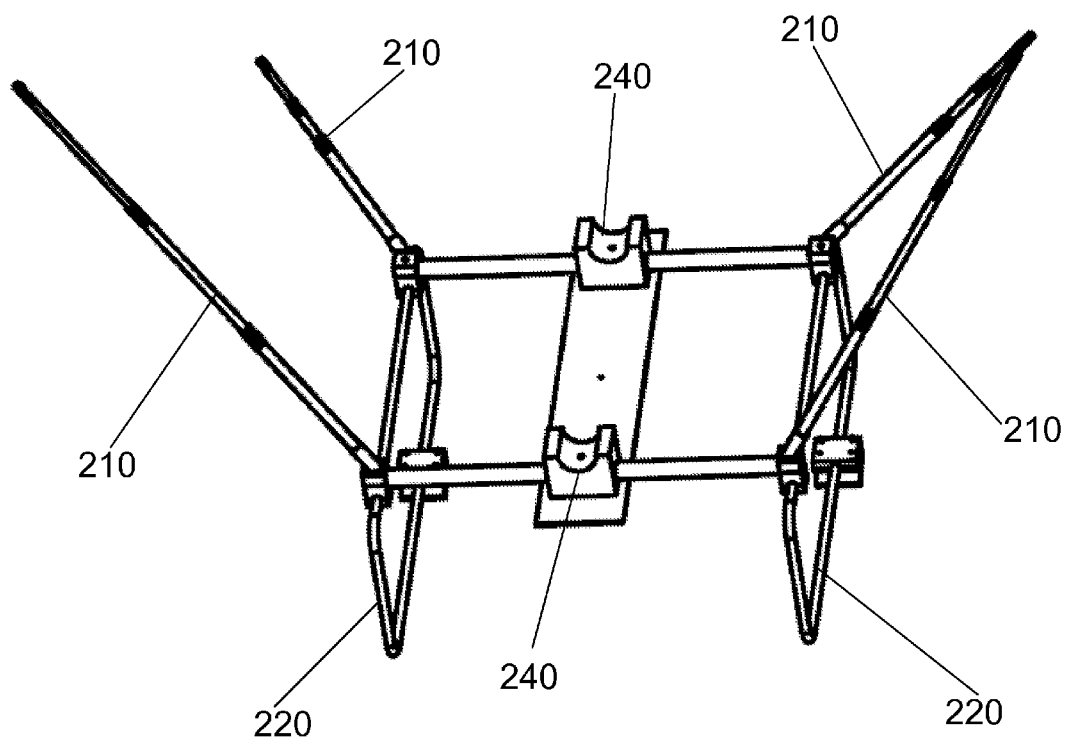


Figure 19

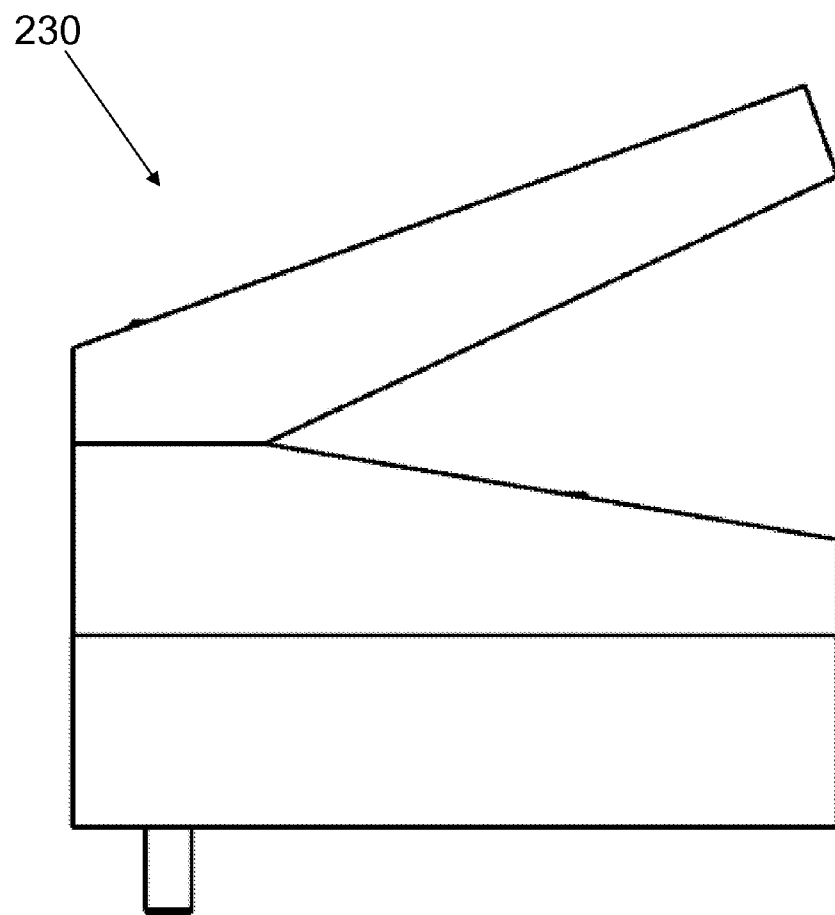


Figure 20

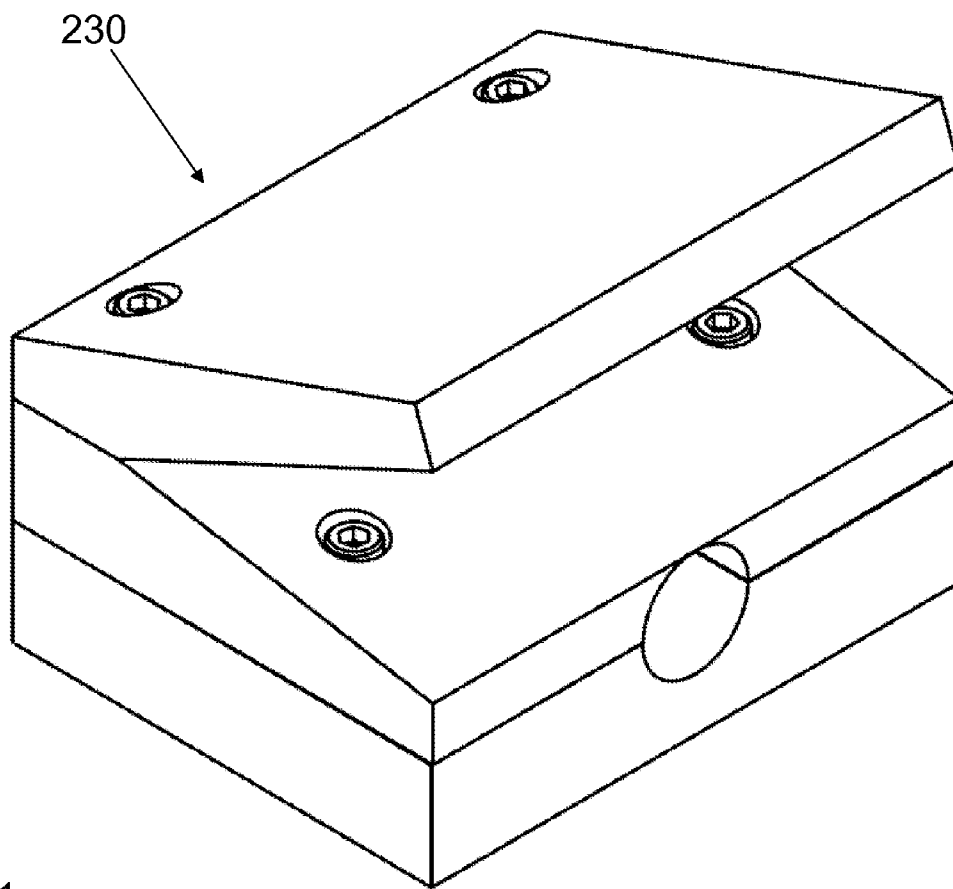


Figure 21

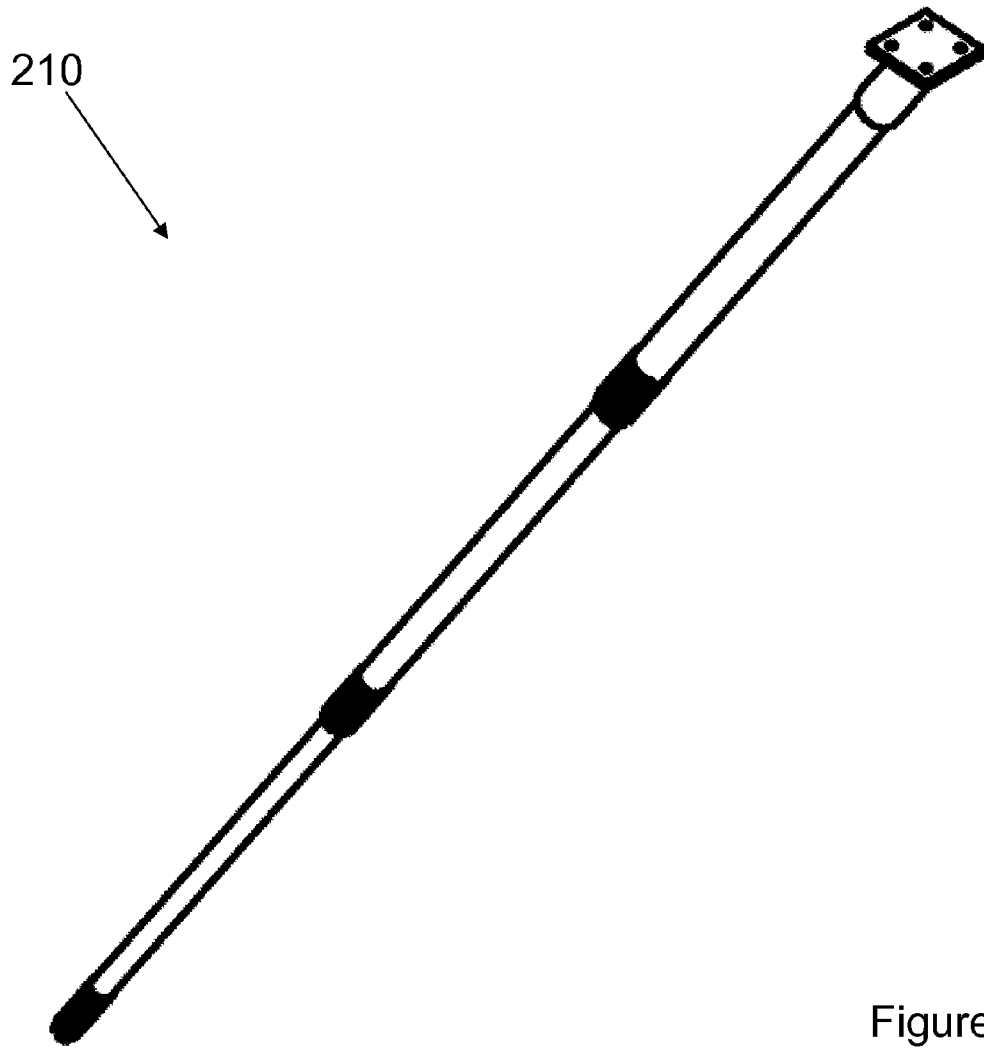


Figure 22

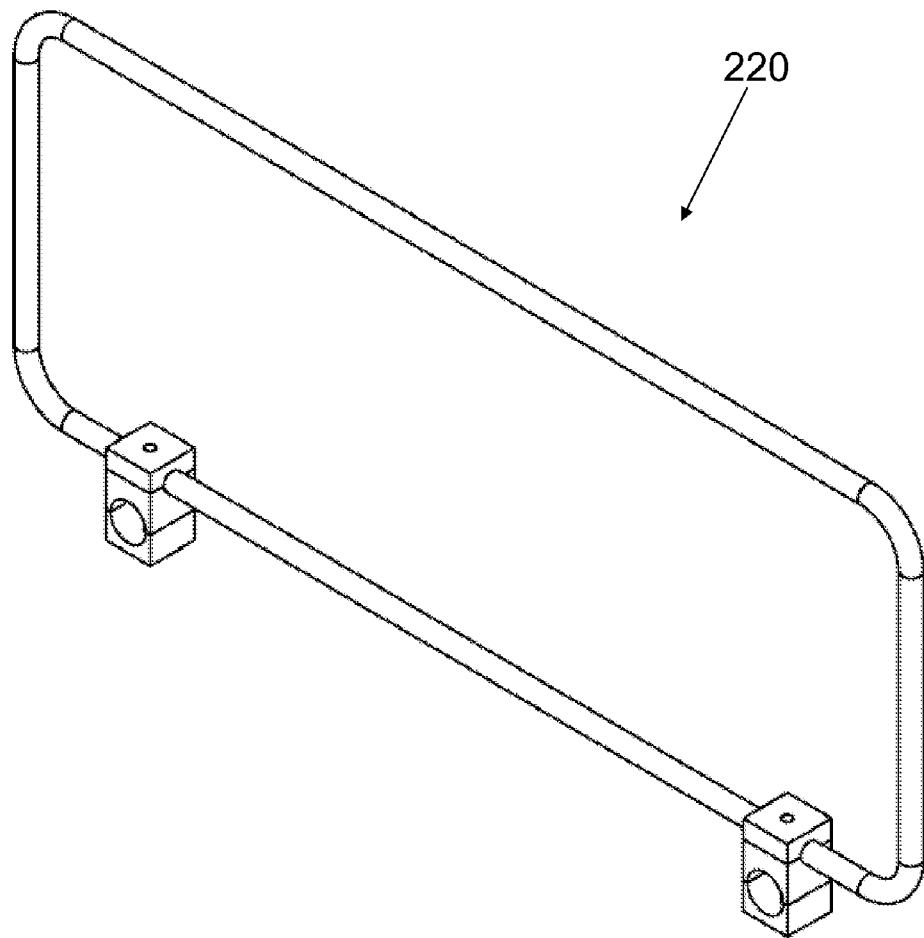


Figure 23

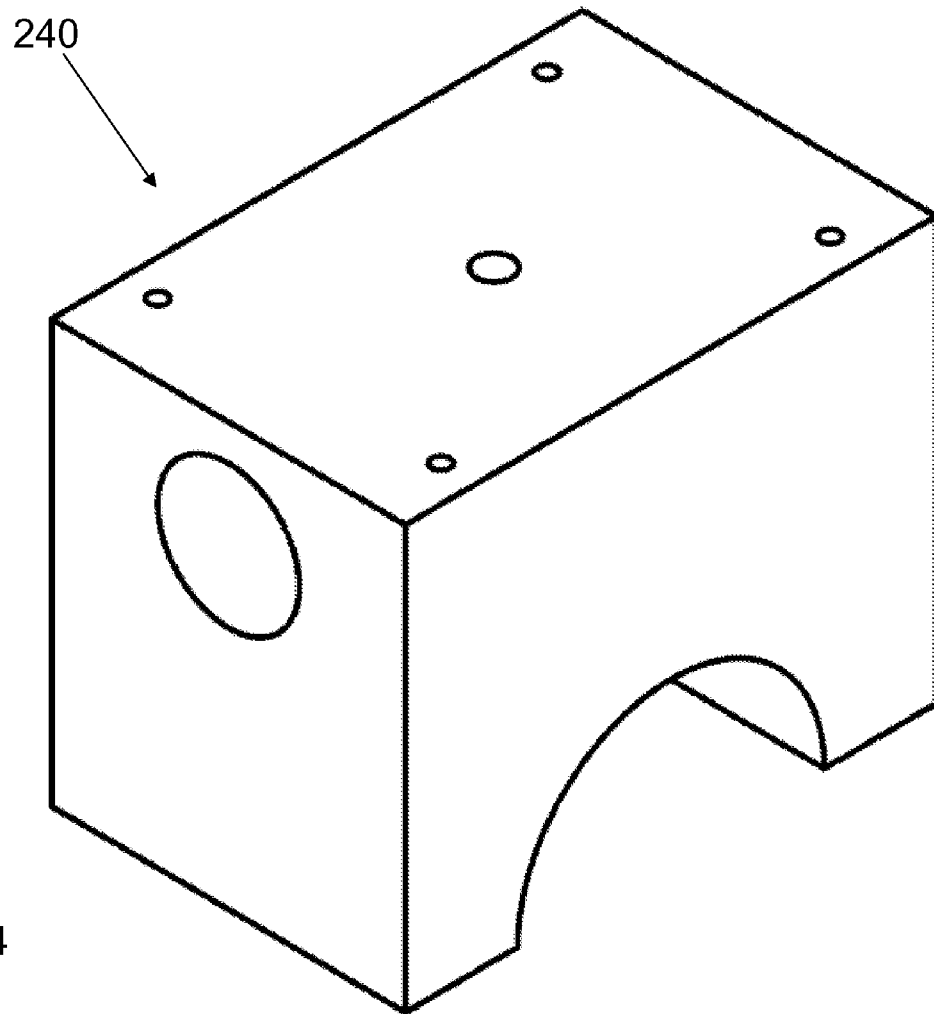


Figure 24

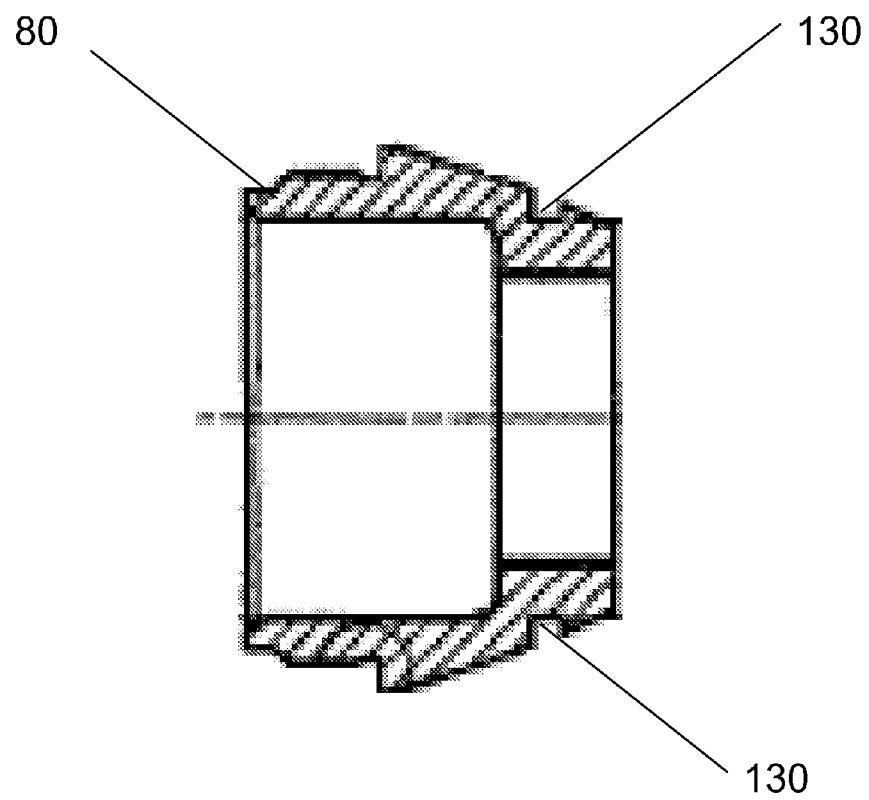


Figure 25

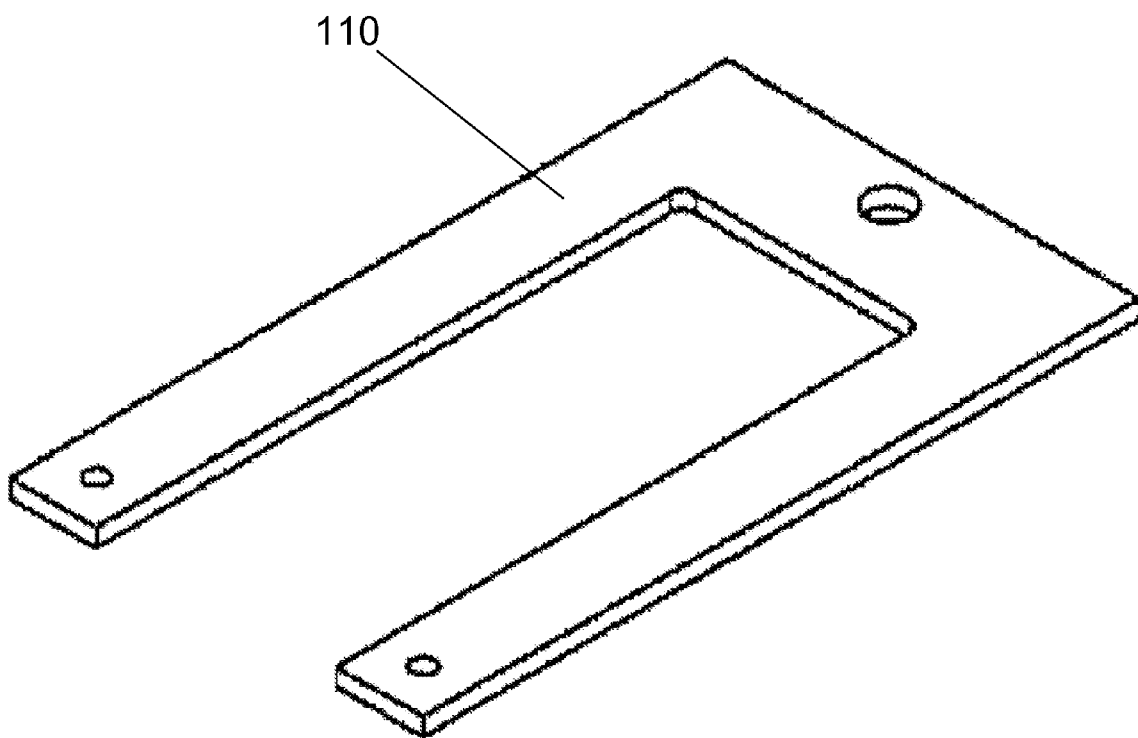


Figure 26

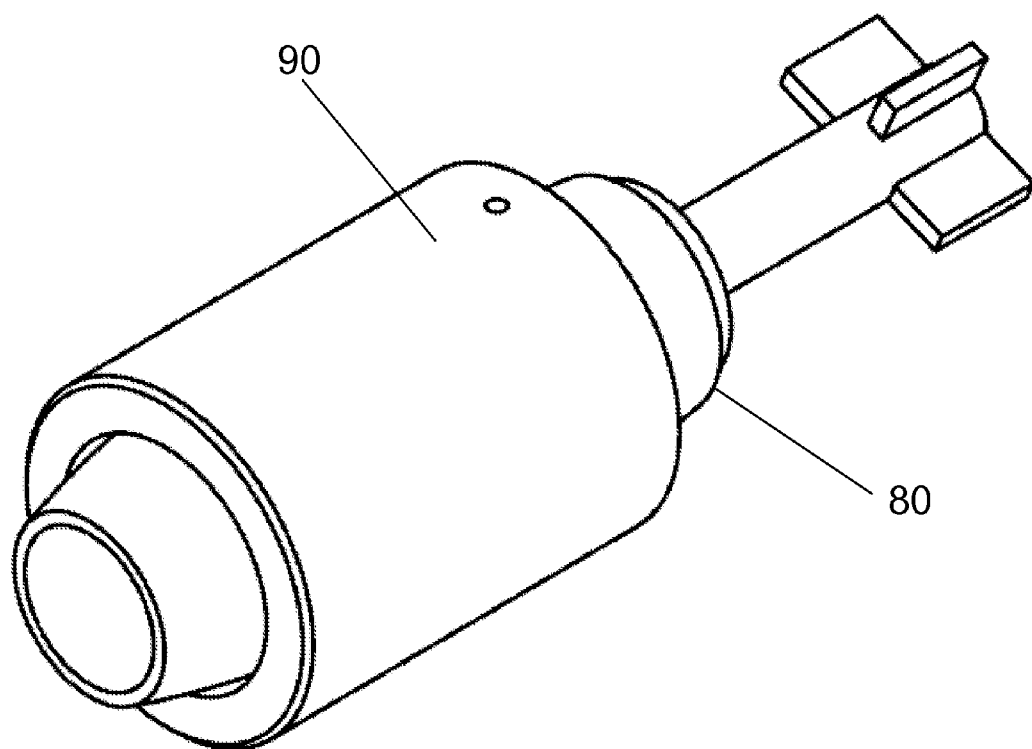


Figure 27

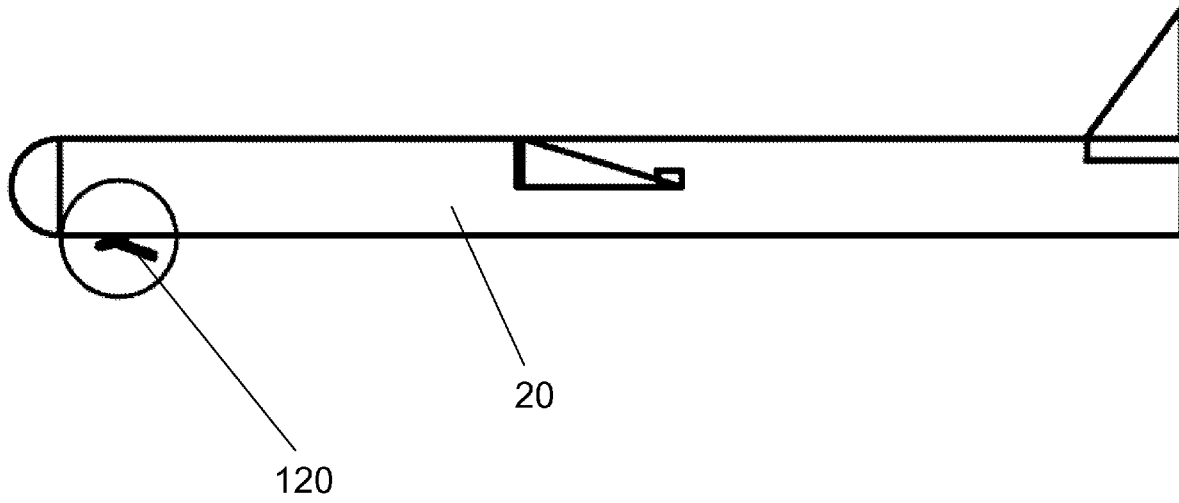


Figure 28

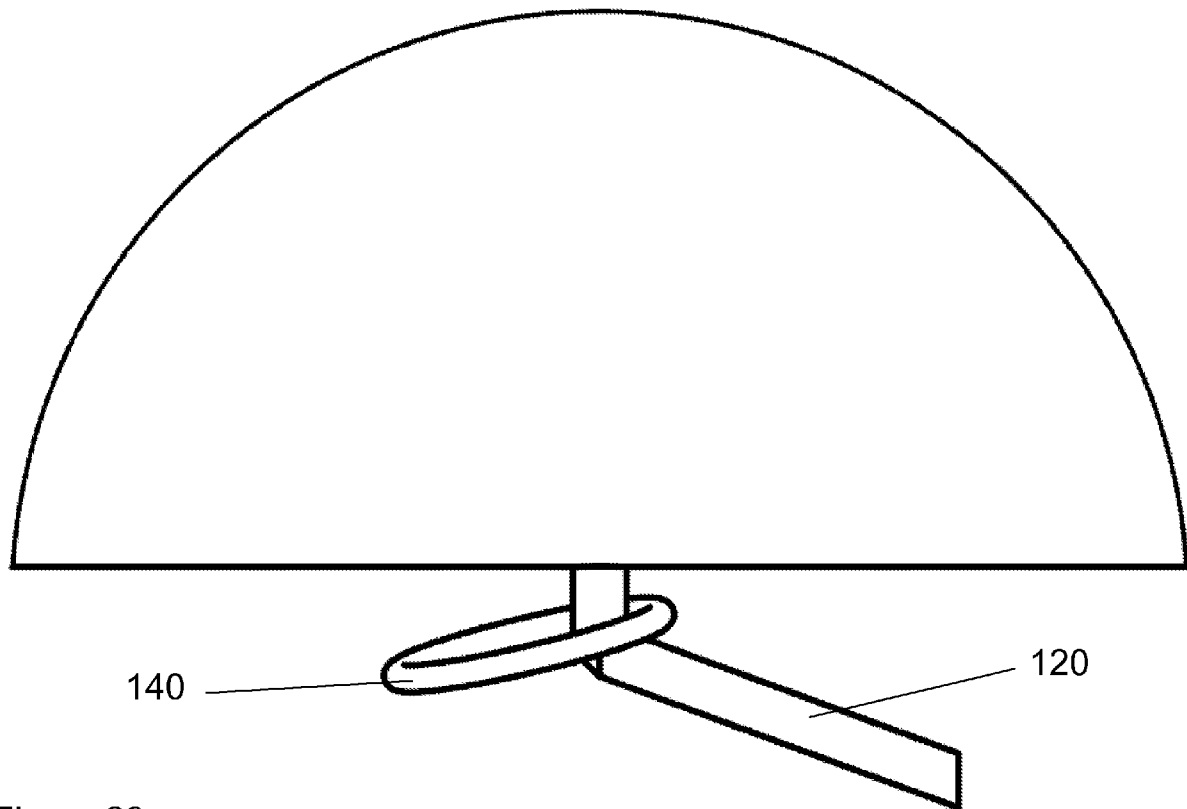


Figure 29

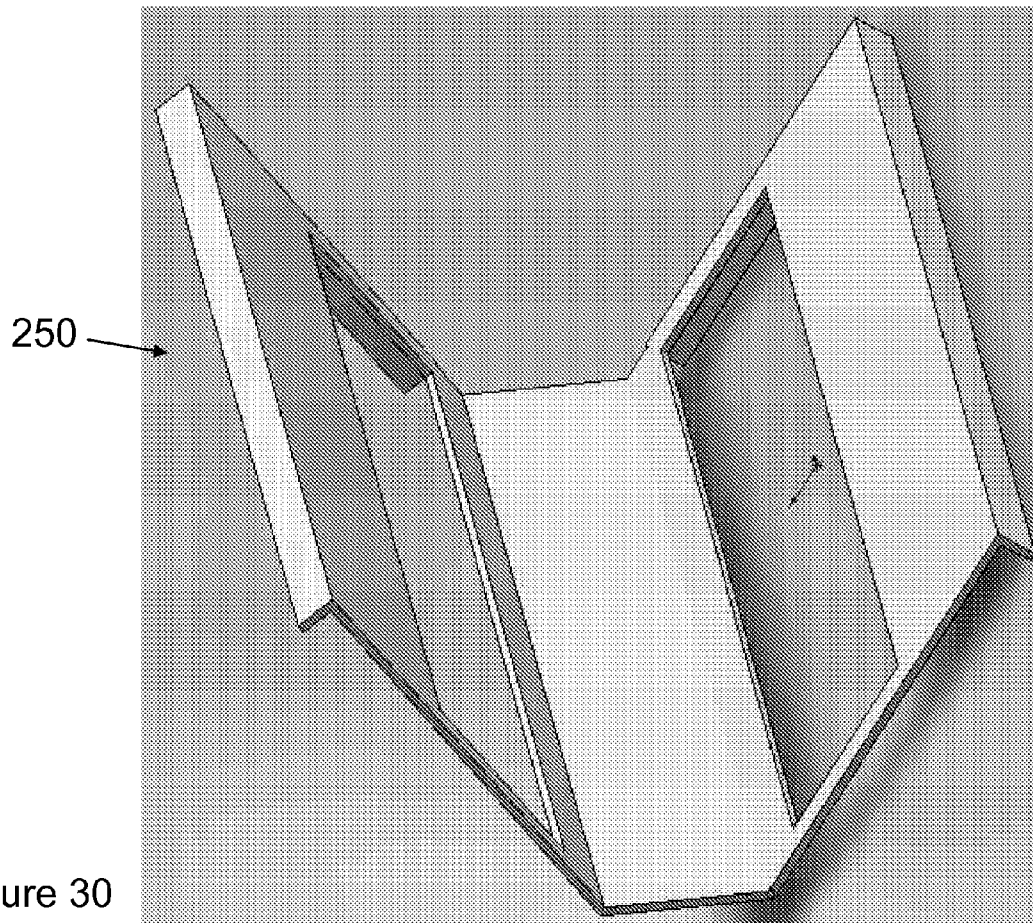


Figure 30

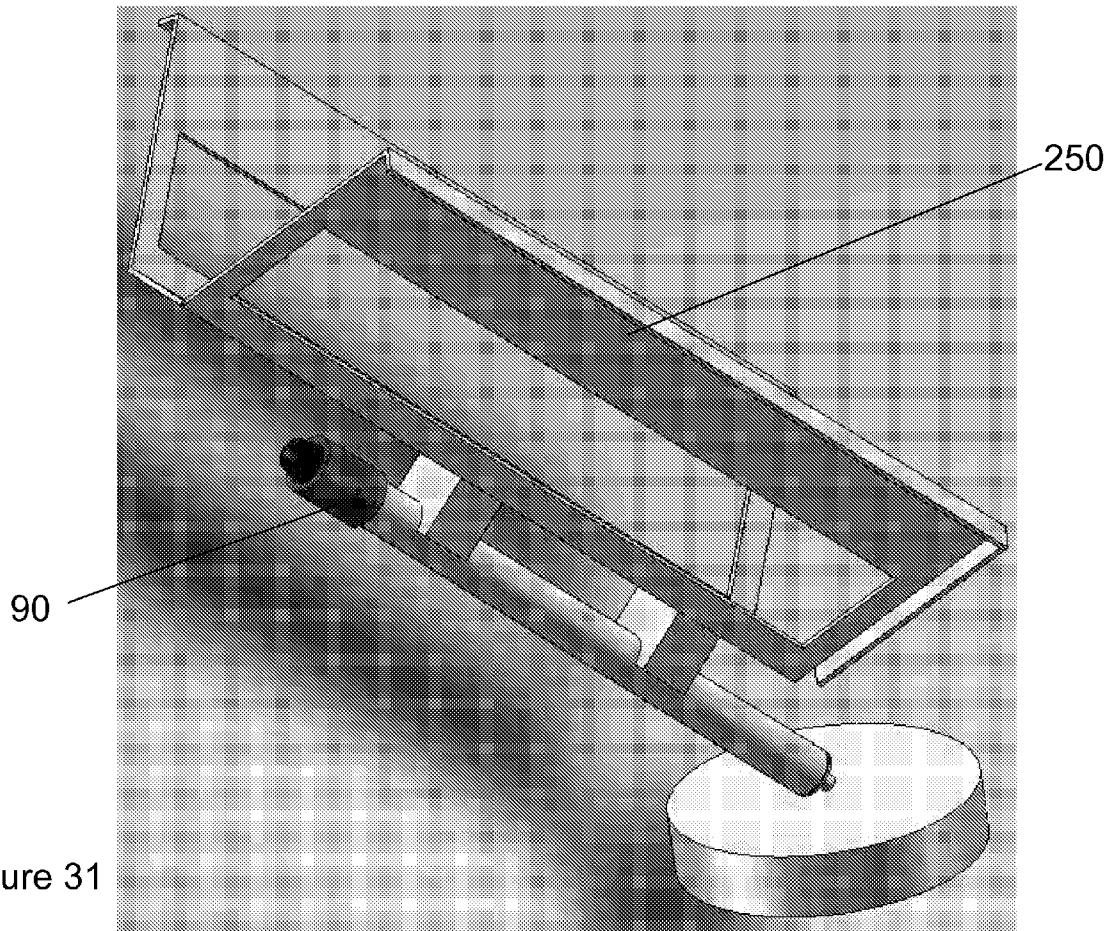


Figure 31



EUROPEAN SEARCH REPORT

Application Number
EP 08 27 5016

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 32 34 351 A1 (MESSERSCHMITT BOELKOW BLOHM [DE]) 17 May 1984 (1984-05-17) * page 6, lines 19-28 * * figures 1,2 *	1-4,10	INV. F41B3/02 F41F3/045
X	US 4 410 151 A (HOEPPNER HEINZ-JOCHEN [DE] ET AL) 18 October 1983 (1983-10-18) * abstract * * column 3, line 51 - column 4, line 42 * * figures 1,6 *	1-4,10	
X	US 4 666 105 A (DELLINGER JUERGEN [DE] ET AL) 19 May 1987 (1987-05-19) * abstract * * column 3, line 10 - column 4, line 66 * * figure 1 *	1-4,10	
A	US 2 748 529 A (SWAN CHARLES R) 5 June 1956 (1956-06-05)		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			F41F F41B
Place of search		Date of completion of the search	Examiner
The Hague		9 January 2009	Menier, Renan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 27 5016

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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09-01-2009

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