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[Continued on next page]

(54) Title: CANTILEVERED SAIL RIG

(57) Abstract: A wind powered craft carrying a generally vertical mast which is rotatable about its vertical axis, having a sail carried by the mast with its bottom edge attached in proximity to the bottom of the mast and extending to an attachment point in proximity to the top of the mast. A generally horseshoe-shaped member having an open end is and extending around said mast. The mast being rotatable within the horseshoe-shaped member. A bearing supported stationary member at the top of the mast is carried by the mast while allowing the mast to rotate. A support stay runs from the horseshoe-shaped member to the bearing supported member to support the horseshoe-shaped member. Additional stays are attached to the horseshoe-shaped member and splayed to attach to opposed sides of the hull of the watercraft. The sail is reefed around the mast through the open end of the horseshoe-shaped member.

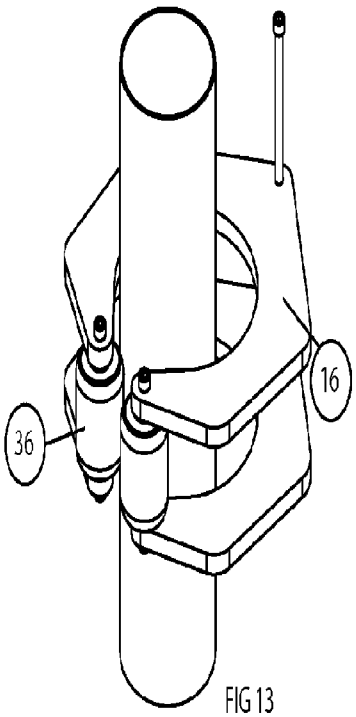


FIG 13

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TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

CANTILEVERED SAIL RIG

This patent application claims the benefit of the filing date of United States Provisional Patent Application Serial No. 61/919,391, filed December 20, 2013, and United States Patent Application Serial No. 14/546,339, filed November 19, 2014, the disclosures of which are incorporated herein by reference.

FIELD OF INVENTION

This invention relates to novel watercraft.

BACKGROUND OF INVENTION

Sailboats rely on harnessing the power of the wind to create propulsion. In its most basic form, this is accomplished by affixing a vertical mast to the boat with a sail attached to the length of the mast on one side, and to an adjustable rope on the opposite corner. To support the load on the mast, the mast is connected in a cantilever fashion to the hull. Most sail rigs include a compressive member attached to the lower end of the mast below the sail, extending horizontally to the opposite tip of the sail. This

is referred to as a boom. To improve the aerodynamics of the sail, battens are often integrated into the sail cloth. Battens are most commonly constructed of fiberglass rods, and are oriented in a generally horizontal position, spaced out along the vertical length of the sail.

A variation on this conventional rig allows the mast to spin around its vertical axis. This is achieved by supporting a short length of the base of the mast with bearings. Spinning the mast consequently causes the sail to wrap, or furl around the diameter of the mast. This is a benefit to the functionality of the sailboat, allowing the user to furl or unfurl the sail to attain the appropriate amount of sail area for the conditions, or completely furl the sail. Furling the sail around the mast requires the sail to not have horizontal battens, as they are not flexible enough to wrap around the small diameter of the mast. Instead, diagonal battens are used. The compromise to this style of rig is that supporting the mast only at the base compromises the efficiency of the rig because the tip of the mast bends away under the load of the wind, decreasing the amount of power that can be harnessed. It also requires a very strong connection between the hull and the mast, and a stiff mast.

In an effort to increase strength and decrease weight, many sailboats use stays to transmit the load of the mast to the hull of the boat. Stays are the tension members. They are wires or ropes affixed to the mast approximately two-third to three-quarters up the length of the mast. Supporting the mast at this location allows for a balanced wind loading of the mast, minimizing bending and therefore keeping an optimized sail shape.

These stays extend down to the left and right sides of the hull and the front of the hull. Using stays to support the mast allows the base of the mast to be simply supported on the hull. It also decreases the strength requirements of the supporting hardware due to the larger moment arm, decreasing the weight of the rig.

In high wind conditions, it can be necessary to decrease the amount of sail area to avoid overpowering or capsizing a sailboat. With a traditional stayed sail rig, the stays are affixed to the mast, precluding the sail from being furled around the mast because it cannot spin. The simplest solution to decreasing sail area with a stayed sail rig is called reefing. In this method, the sail is lowered part way down the length of the mast, and the lower section of the sail is gathered at the bottom of the sail. While this works, it is not very quick or tidy. Another design allows for a boom to spin as the sail is lowered down the length of the mast, furling the sail around the boom. A variation on this design works very similarly, but employs a rotating mandrel inside a hollow boom around which the sail wraps when furled. These two designs require a boom. Another design works in a similar fashion, but furls the sail around a mandrel inside the mast. This design precludes the use of battens and increases the weight of the mast. One more less common design allows for the sail to furl around the mast as it spins, with stays running to the tip of the mast. This is not a common design because only supporting the mast at the top and bottom creates a less optimal sail shape, as the mast bends in the middle. It also makes it difficult to spin the mast under sail load.

SUMMARY OF THE INVENTION

Briefly, the invention comprises a wind powered craft carrying a generally vertical mast supported by stays, said craft comprising means for supporting the mast with the stays along the vertical length of the mast but below the top of the mast while allowing the mast to rotate about its vertical axis.

The invention further comprises a wind powered craft carrying a generally vertical mast which is rotatable about its vertical axis, a sail carried by said mast with its bottom edge attached in proximity to the bottom of the mast and extending to an attachment point in proximity to the top of the mast, a first member having an open end and partially extending around said mast, the mast being rotatable within said member, a bearing mounted stationary second member at the top of the mast and carried by the mast while allowing the mast to rotate, a support stay running from said first member to said bearing mounted second member to support said first member, and additional stays attached to said first member and splayed to attach to opposed sides of the hull of the watercraft, said sail being reefed around said mast through the open end of said first member by rotation of the mast.

More particularly, the invention comprises a watercraft carrying a generally vertical mast which is rotatable about its vertical axis, a sail carried by said mast with its bottom edge attached in proximity to the bottom of the mast and extending to an attachment point in proximity to the top of the mast, a generally horseshoe-shaped

member having an open end and partially extending around said mast, the mast being rotatable within the horseshoe-shaped member, a bearing mounted stationary member at the top of the mast and carried by the mast while allowing the mast to rotate, a support stay running from said horseshoe-shaped member to said bearing mounted member to support the horseshoe-shaped member, and additional stays attached to said horseshoe-shaped member and splayed to attach to opposed sides of the hull of the watercraft, said sail being reefed around said mast through the open end of said horseshoe-shaped member by rotation of the mast.

According to the present invention, the rig is properly supported by stays which still allow the sail to furl around the mast. To achieve this functionality, instead of attaching the stays directly to the mast, they are attached to a preferably horseshoe-shaped component which partially encompasses the mast in the same location approximately 2/3 to 3/4 up the length of the mast, but is not attached to the mast. From this horseshoe, a support stay is run to the tip of the mast where it is affixed to a bearing, allowing the mast to rotate. This system allows for the vertical component of the force from the stays to be supported by the support stay leading to the tip of the mast, and the horizontal component of the force to be supported by the horseshoe. This device also allows the sail to furl around the mast, passing through the gap between the two ends of the horseshoe. To facilitate lower friction when furling and avoid damaging the sail cloth, rollers are attached to the ends of the horseshoe, allowing for the sail to feed through and wrap around the mast even when under load.

THE DRAWINGS

In the drawings:

Figure 1 is a perspective view from the right rear of a catamaran equipped with the sail rig of the present invention.

Figure 2 is a top view of a catamaran equipped with the sail rig of the present invention.

Figure 3 is a rear view of a catamaran equipped with the sail rig of the present invention.

Figure 4 is a side view of a catamaran equipped with the sail rig of the present invention.

Figure 5 is an enlarged view of the top of the mast taken at A in Figure 4.

Figure 6 is an enlarged top view of the mast of the catamaran shown in Figures 1 to 4, showing in more detail the horseshoe-shaped member.

Figure 7 is a front view of the mast carrying the horseshoe-shaped member and the first stay running from the horseshoe-shaped member to the top of the mast and the two splayed stays running to opposite sides of the catamaran.

Figure 8 is a view of the mast of Figure 7 taken from the side.

Figure 9 is a rear view of the mast of Figure 7.

Figure 10 is a side view of the top of the mast showing the first stay and the bearing supported member carried at the top of the mast.

Figure 11 is a top view of the top of the mast as shown in Figure 10.

Figure 12 is a partial sectional view taken along the line 12-12 in Figure 11.

Figure 13 is a perspective view of that portion of the mast carrying the horseshoe-shaped member and the first stay.

Figure 14 is a view looking down on the mast, horseshoe-shaped member and first stay of Figure 13.

Figure 15 is a rear view of the mast, horseshoe-shaped member and first stay of Figure 13.

Figure 16 is a side view of the mast, horseshoe-shaped member and first stay of Figure 13.

Figure 17 is a top view of the mast showing the sail as it is being furled around the mast as the mast is rotated.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning to the drawings in more detail, the watercraft 10 has a vertical mast 12 which is rotatable about its own vertical axis and is retained in a suitable fitting within the structure of the watercraft. The mast 12 carries sail 14.

The first member preferably is generally a horseshoe-shaped member 16 having an open end or gap 18 and otherwise extends around the mast. The horseshoe-shaped member 16 is supported by a stay 20 running from horseshoe-shaped member 16 to a second member which is bearing mounted member 22 carried by the top 24 of the mast 12. The bearings are shown in Figure 10 at 26.

The mast 12 is freely rotatable within the horseshoe-shaped member 16 and also with respect to the bearing mounted member 22.

Additional stays 28 and 30 extend from the horseshoe-shaped member 16 to the sides of the watercraft at 32 and 34, respectively.

In furling, the sail 14 passes through the gap 18 between guide rollers 36 located at each side the open end 18 of horseshoe-shaped member 16. As the mast is rotated, the sail 12 is snugly furled around the mast 12, as show in Figure 17.

When the sail 12 is unfurled, the free end is held by stay 38 attached to cross-member 40.

The sail 14 has a sleeve 42 or pocket along the length of its front end. When assembled with the mast 12, the mast is inserted into sleeve 42 and then the sail is affixed top and bottom to the mast. In this way when the sail is furled, it starts to wind around the mast as the mast is rotated.

The watercraft shown is a catamaran. However, the invention is applicable to sail boats generally, as will be apparent to those skilled in the art.

CLAIMS

1. A wind powered craft carrying a generally vertical mast supported by stays, said craft comprising;

a means for supporting the mast with the stays along the vertical length of the mast but below the top of the mast while allowing the mast to rotate about its vertical axis.

2. A wind powered craft carrying a generally vertical mast which is rotatable about its vertical axis;

a sail carried by said mast with its bottom edge attached in proximity to the bottom of the mast and extending to an attachment point in proximity to the top of the mast;

a first member having an open end and partially extending around said mast, the mast being rotatable within said member;

a bearing mounted stationary second member at the top of the mast and carried by the mast while allowing the mast to rotate;

a support stay running from said first member to said bearing mounted second member to support said first member;

additional stays attached to said first member and splayed to attach to opposed sides of the hull of the watercraft, said sail being reefed around said mast through the open end of said first member by rotation of the mast.

3. A watercraft carrying a generally vertical mast which is rotatable about its vertical axis;

a sail carried by said mast with its bottom edge attached in proximity to the bottom of the mast and extending to an attachment point in proximity to the top of the mast;

a generally horseshoe-shaped member having an open end and partially extending around said mast, the mast being rotatable within the horseshoe-shaped member;

a bearing mounted stationary member at the top of the mast and carried by the mast while allowing the mast to rotate;

a support stay running from said horseshoe-shaped member to said bearing mounted member to support the horseshoe-shaped member;

additional stays attached to said horseshoe-shaped member and splayed to attach to opposed sides of the hull of the watercraft, said sail being reefed around said mast through the open end of said horseshoe-shaped member by rotation of the mast.

4. The watercraft of claim 1 or 2 or 3 wherein the open end of said horseshoe-shaped member has opposed rollers for contacting and guiding the sail as it is reefed around the mast.

5. The watercraft of claim 1 or 2 or 3 wherein the horseshoe-shaped member is positioned approximately two-thirds to three-quarters up the length of the mast.

6. The watercraft of claim 1 or 2 or 3 wherein the watercraft is a catamaran.

FIG 2

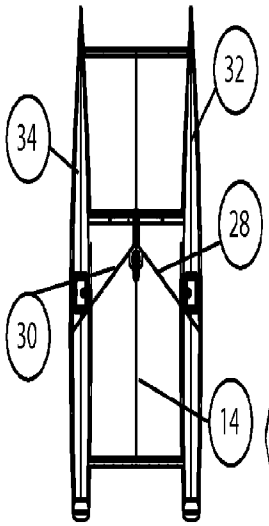
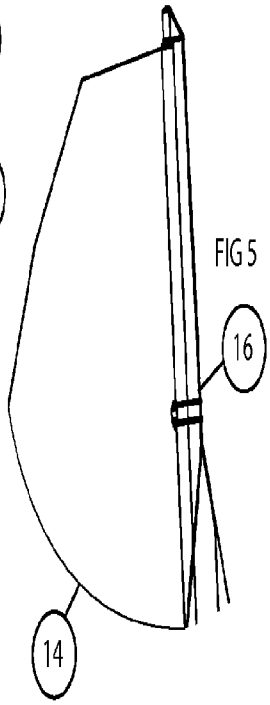


FIG 5



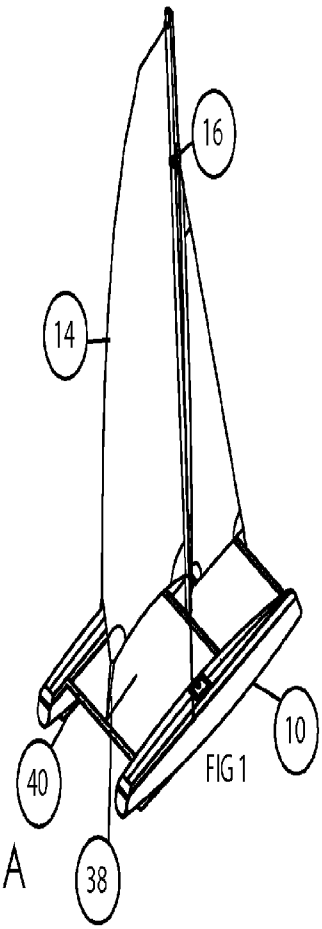


FIG 1

DETAIL A

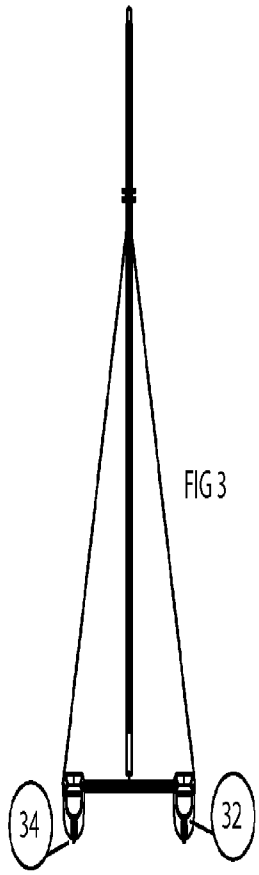


FIG 3

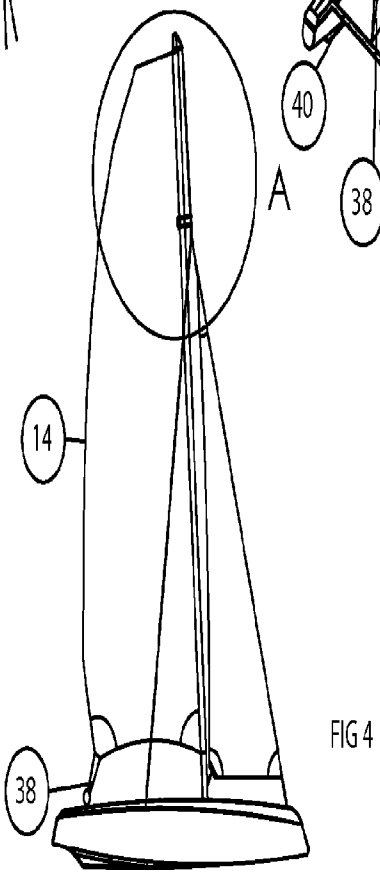


FIG 4

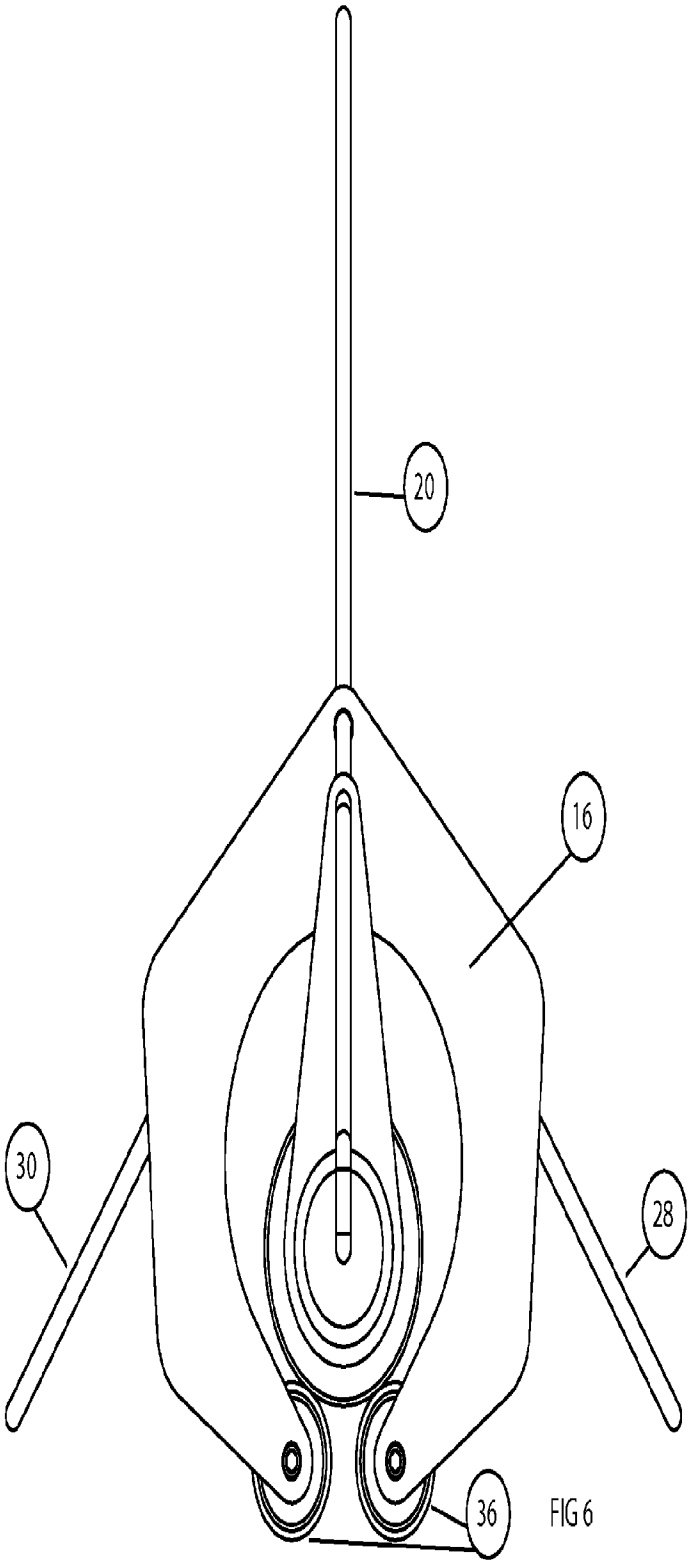


FIG 6

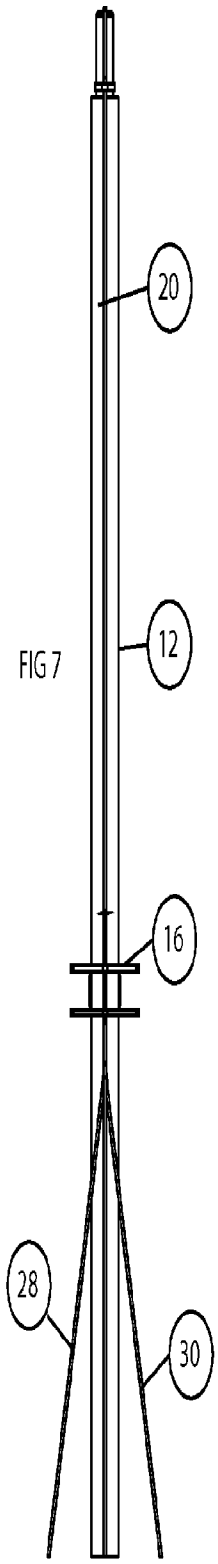


FIG 7

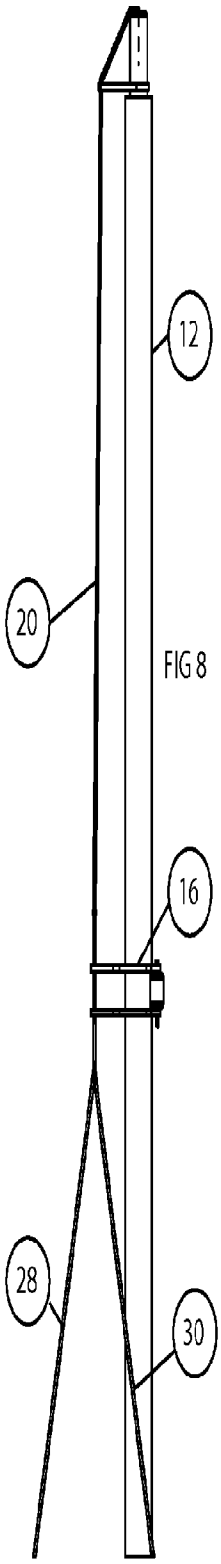


FIG 8

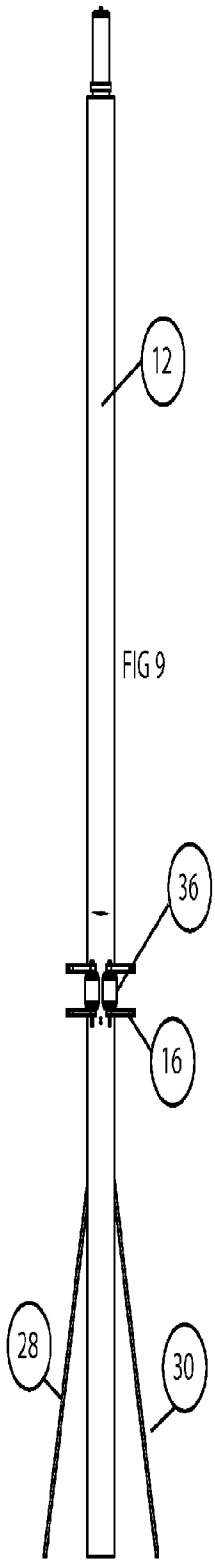


FIG 9

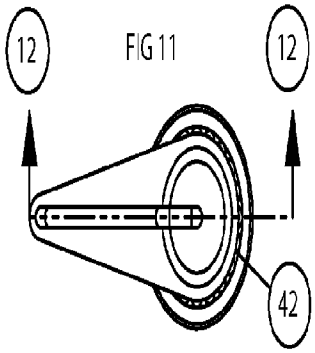


FIG 11

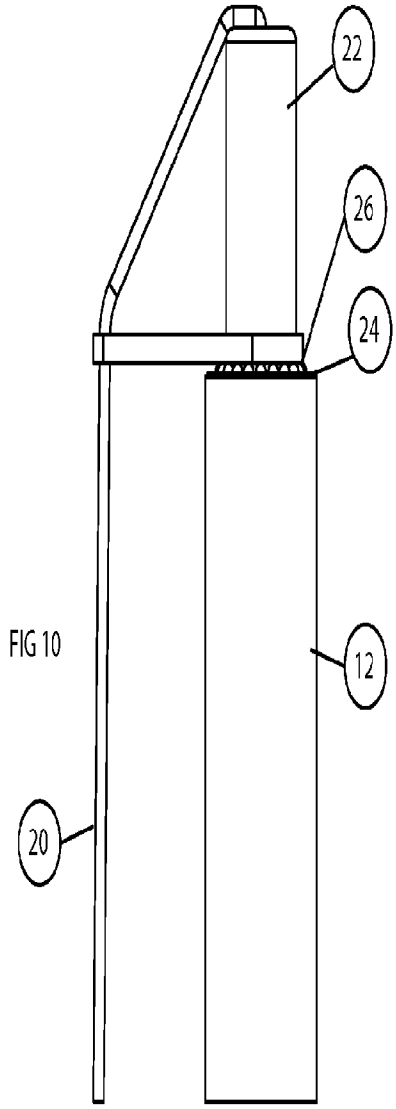


FIG 10

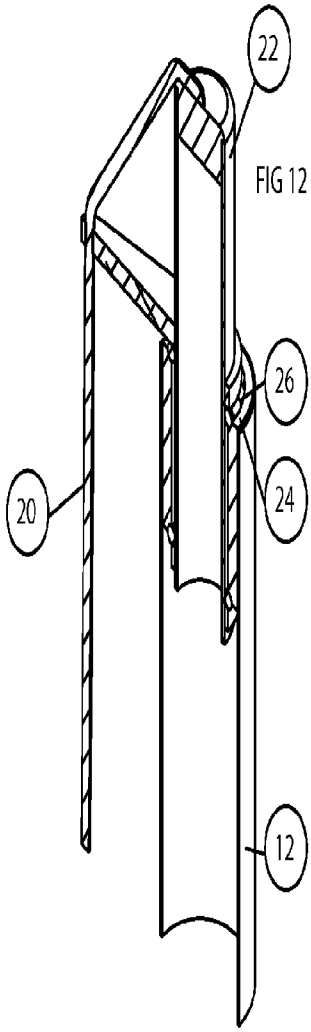


FIG 12

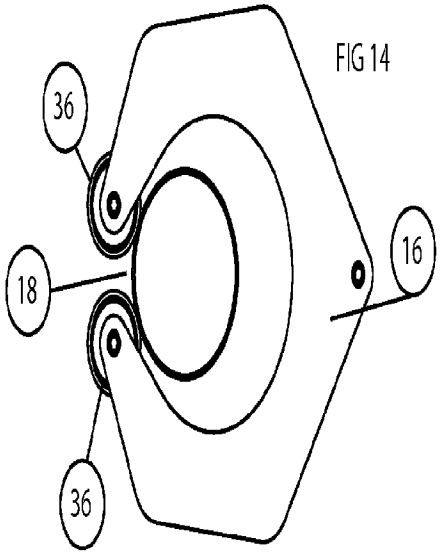


FIG 14

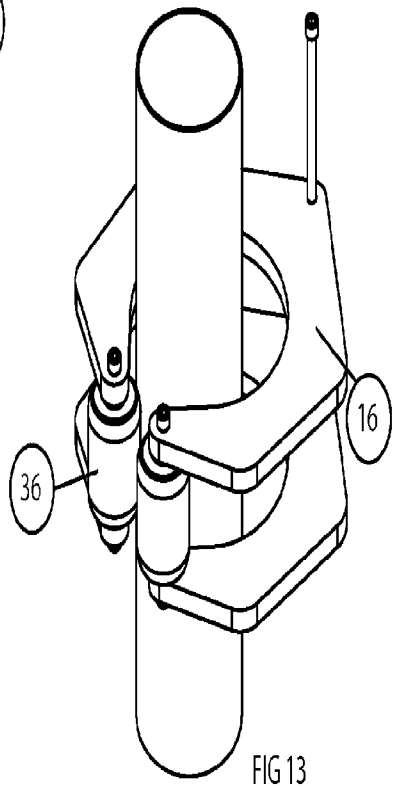


FIG 13

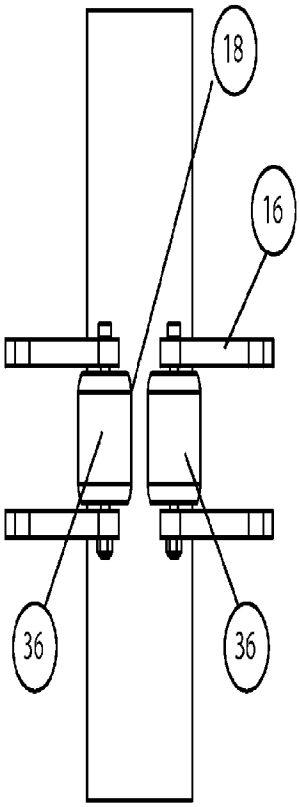


FIG 15

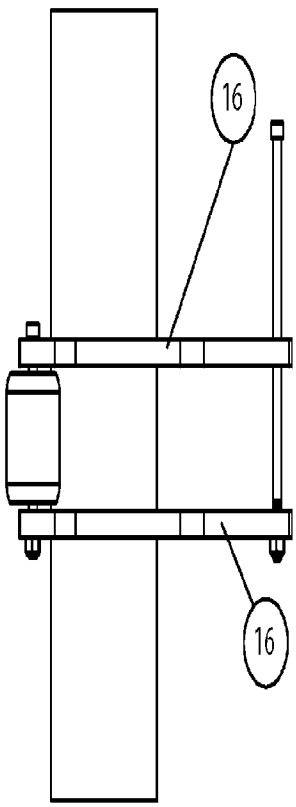


FIG 16

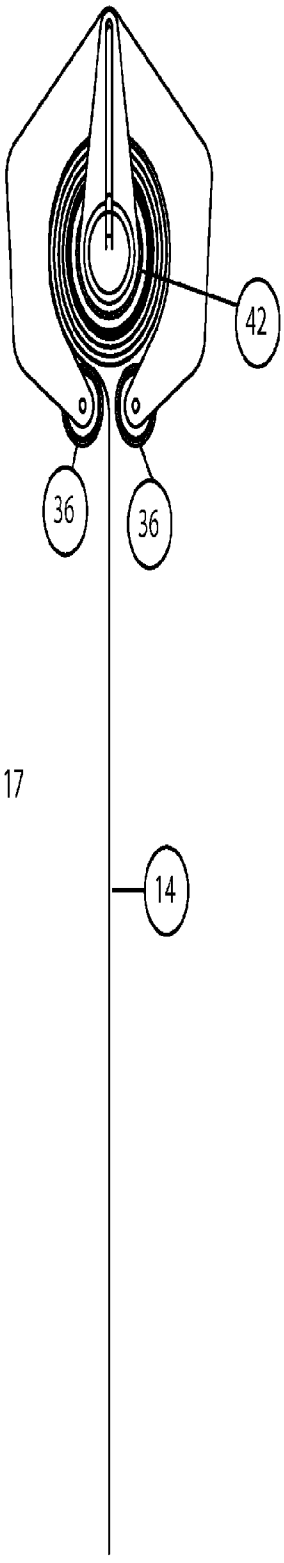


FIG 17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US14/68086

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B63H 9/06 (2015.01)
CPC - B63H 9/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classification(s): B63H 9/06, 9/08, 15/00 (2015.01); CPC Classification(s): B63H 9/06, 9/0642, 9/08; USPC Classification(s): 114/102.1, 102.16, 102.24, 104, 108, 112, 126

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)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); ProQuest (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstract Online, Inside Conference); IEEE/IEEEXplore; Google/Google Scholar; Keywords: wind w2 craft*, watercraft*, catamaran*, sail w2 boat*, boat*, sailboat*, clipper, schooner, Sail*, Float*, Drift*, Mast*, Pole*, Post*, stays, support w2 stay*, cord*, cable*, length, dimension, height, top, Rotate*, revolv*, swivel*, pivot*, Vertical w2 axis, axis, bearing*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4,435,125 A (COOK, GE) March 6, 1984; figures 1, 2, 3a, 4, 11; column 5, lines 55-68; column 6, lines 5-15 and lines 25-30; column 7, lines 10-20, lines 35-45 and lines 50-55; column 8, lines 25-35; column 9, lines 55-65; column 11, lines 30-35	1-3, 4/1-4/3, 5/1-5/3, 6/1-6/3
A	US 3483840 A (PROLSS, W) December 16, 1969; entire document	1-3, 4/1-4/3, 5/1-5/3, and 6/1-6/3
A	US 4,690,088 A (PERINI, F) September 1, 1987; entire document	1-3, 4/1-4/3, 5/1-5/3, and 6/1-6/3

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"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
31 January 2015 (31.01.2015)	04 MAR 2015
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)