United States Patent [19]

Wortmann

[11] **3,820,489**

[45] **June 28, 1974**

[54] **SAFETY RIG FOR MULTI-HULL BOATS**

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[73] Assignee: **Kortenbach & Rauch Kommanditgesellschaft,** Soligen-Weyer, Germany

[22] Filed: **Dec. 14, 1972**

[21] Appl. No.: **315,084**

[30] **Foreign Application Priority Data**

Dec. 21, 1971 Germany 2163329

[52] **U.S. Cl.** **114/39,** 114/91

[51] **Int. Cl.** **B63h 9/00**

[58] **Field of Search** 114/39, 91, 102

[56] **References Cited**

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Primary Examiner—Trygve M. Blix
Assistant Examiner—Stuart M. Goldstein
Attorney, Agent, or Firm—Walter Becker

[57] **ABSTRACT**

A multi-hull boat having its floating bodies interconnected by traverses and being equipped with a mast mounted on the deck by means of shrouds and braces, said mast being tiltable toward the port side and the starboard side while spring means are provided between the anchoring means for the shrouds.

6 Claims, 5 Drawing Figures

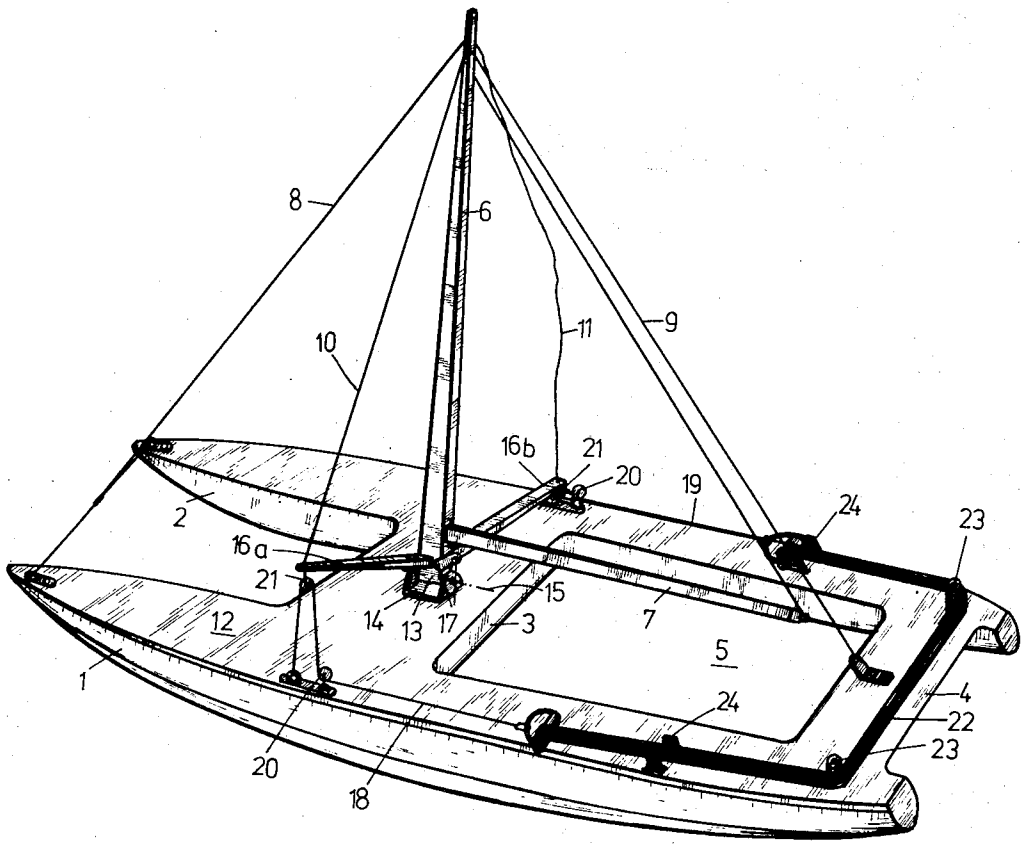


Fig.1

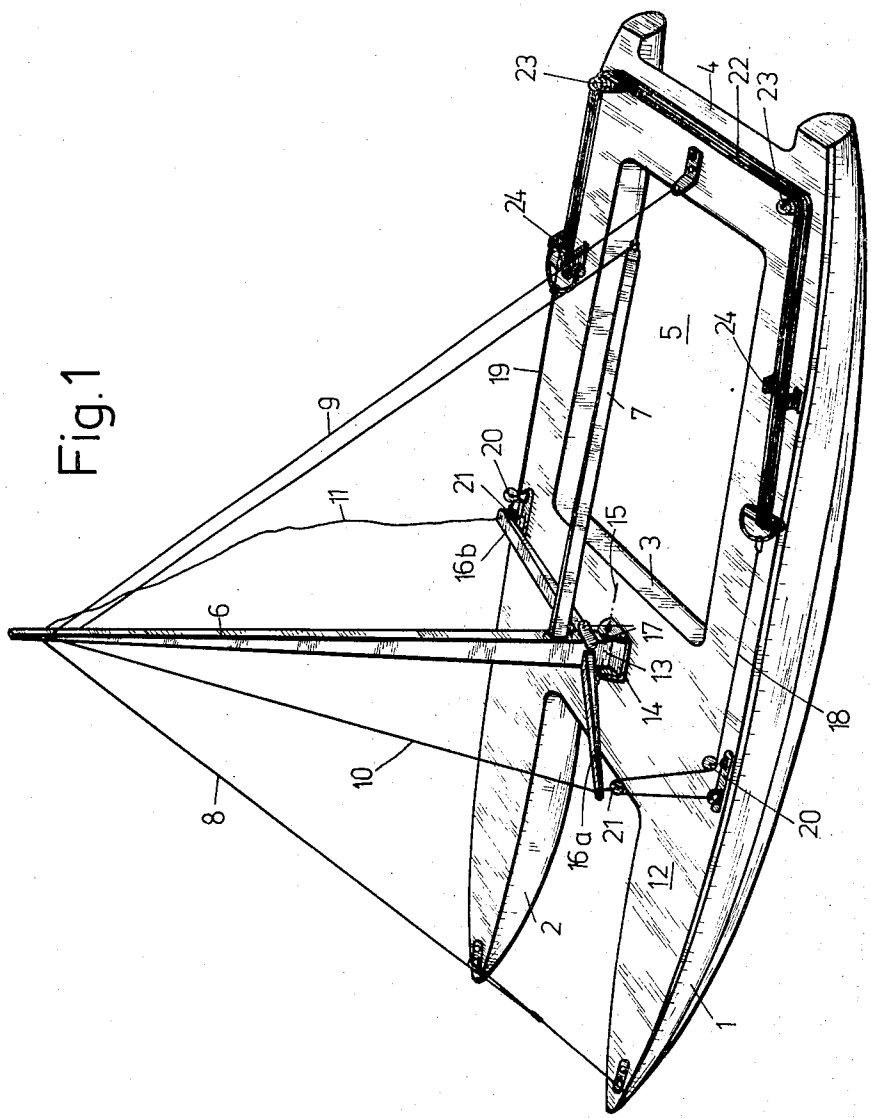

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Fig. 2

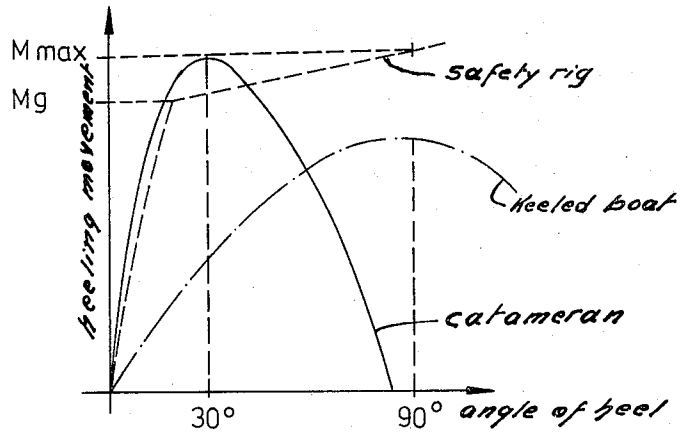


Fig. 3

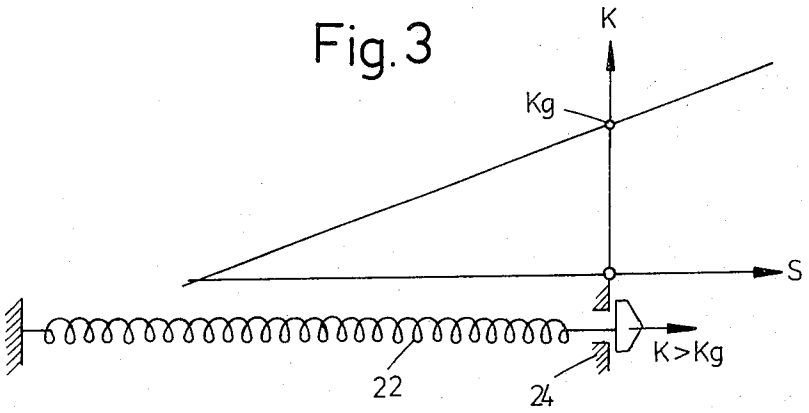


Fig. 4a

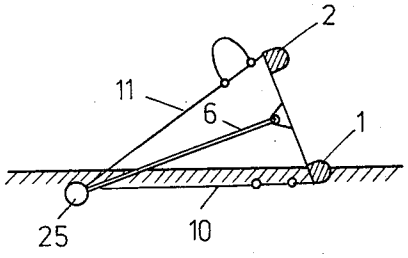
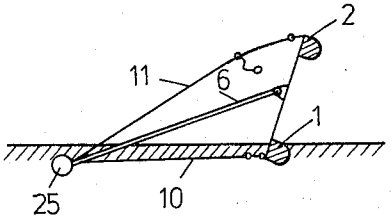


Fig. 4b



SAFETY RIG FOR MULTI-HULL BOATS

The present invention relates to a safety rig for multi-hull boats, the floating bodies of which are connected by traverses, and more specifically, concerns a rig of the just mentioned type which is equipped with braces and shrouds in a shoe on a mast mounted on the deck, said mast being tiltable toward the port side and starboard about a pivot axis.

Only a partial component of the wind force acting upon the sail becomes effective as propelling force. A considerably greater transverse force which acts perpendicularly with regard to the propelling force tends to list or heel the boat about its longitudinal axis. It is for this reason that sailing boats require a greater stability about its longitudial or fore-and-aft axis than other water vehicles. When distributing the water displacement to a plurality of hulls as in a catamaran, it is possible weight for weight to obtain a considerably greater starting stability than is the case with a boat having only one hull. A further advantage of the multi-hull boats consists in their decreased wave resistance due to the narrower width of the individual hulls, so that higher speeds become possible.

The heretofore known multi-hull boats with a rigidly braced rig have the drawback that they may capsize because the maximum stability prevails with a lower listing angle than is the case with one-hull boats having a ballast keel. Whereas the stability of a multi-hull boat reaches its maximum value at a heel or listing angle of from 20° to 30° and drops steeply at a greater heel, the stability of a one-hull boat with a ballast keel increases continuously up to a heel of approximately 90° without the existence of a direct capsizing danger. These conditions clearly indicate that with multi-hull boats there exists an urgent requirement for a well-functioning safety rig.

It is, therefore, an object of the present invention to provide a safety rig for multi-hull boats by means of which the very much desired high starting stability can be retained while at the same time the capsizing moment exerted by the force of the wind will be limited to a maximum value which corresponds approximately to the maximum stability, i.e. the maximum righting moment of the boat.

It is another object of this invention to provide a safety rig which will overcome the drawbacks of heretofore known rigs of the type under consideration.

These and other objects and advantages of the invention will appear more clearly from the following specification, in connection with the accompanying drawings, in which:

FIG. **1** shows an isometric illustration of a catamaran without sail.

FIG. **2** is a heel diagram with heel curves for a multi-hull boat and a keeled boat respectively.

FIG. **3** shows a force-stroke characteristic of a pre-loaded spring.

FIGS. **4***a* and **4***b* represent a diagrammatic illustration of a catamaran in a capsized position.

For multi-hull boats the floating bodies of which are interconnected by traverses and which are equipped with a mast mounted with stays and shrouds in a shoe on the deck of the boat, and in which the mast is tiltable about a pivot axis toward port side and starboard, the problem underlying the present invention has been solved by the fact that between the stays and their anchoring means there is arranged a pre-loaded spring. The pre-loading of the spring should correspond to a moment of in excess of from 50 percent, preferably from 70 to 80 percent of the maximum stability of the boat.

The safety rig according to the invention has the advantage that the transverse force which becomes effective as heeling moment can be limited to a limit value by the pre-load and characteristic curve of the spring. As long as the transverse force which acts upon the mast and which may have been produced not only by wind, but also by forces of inertia, remains below the prescribed transverse force, the safety rig according to the invention behaves like a normal rig with rigidly braced mast. A nearly rigid connection of the mast with the boat is desirable for two reasons. On one hand, the sail should be in upright position as long as possible in order to convert a relatively great proportion of the wind forces for the propelling of the ship, and on the other hand, the high inertia moment of the mast stabilizes the rolling movements of the boat, in other words, considerably contributes normally to the sailing comfort.

However, as soon as the transverse force exceeds the predetermined limit value, the mast will, in view of its bracing according to the invention, pivot or tilt leeward. Inasmuch as during the tilting of the mast, the sailing surface projected upon the direction of the wind, decreases, the spring force, however, increases, it will be appreciated that very similar to the conditions of a keeled boat, a new condition of equilibrium develops with tilted masts. The heeling of the boat increases, however, only slightly, and the righting moment of the boat increases further. With a gusty wind, the peaks exceeding the predetermined limit value of the transverse force acting upon the sail are automatically compensated for or balanced by the safety rig without the necessity of the crew becoming active to decrease the sailing surface. When the transverse forces acting upon the mast vary back and forth above the limit value, the safety rig may also be considered to be an elastic inertia storage means which transforms a portion of the excessive wind forces into propelling forces.

A further important advantage of the safety rig according to the invention consists in that when one hull suddenly lifts out of the water, for instance, in view of a steep wave, the high inertia moment of the mast cannot produce inertia forces which exceed the maximum spring tension. This not only protects the stays but, for instance, with trimaranes also protects the traverses against overload, which traverses connect the central hull and the lateral floatation bodies to each other.

According to an actual and practical design, the safety rig according to the invention may be so designed that the lower ends of the shroud are connected to the hull of the boat by means of a pre-loaded spring. In order to make sure that the lever arm of the spring force will also be maintained at a considerable tilting angle of the mast, it is expedient to subject the lower end of the shrouds to an outward thrust by a crosstree or spreader which may be articulated to the heel of the mast.

Furthermore, it has proved advantageous to provide one cable line each with a fixed block and a loose roller between the ends of the spring and said crosstree or spreader so that the force of the spring has to be only half as great as it would otherwise be required corre-

sponding to the predetermined limit value. The outer ends of the spreader may within a certain range be able to slide on the shrouds. In view of the great forces, a fixed connection of the spreaders to the shrouds with a mast adapted to carry out a pendulum movement, is rather dangerous for the crew. For the same reason, also the spring and the counterbearing as well as the fixed roller should not be located unprotected on the deck, but should be arranged below the deck in a shielded manner.

According to a preferred embodiment, the spring itself may consist of rubber strands which, in view of a sufficient spring length, should be passed aft over two deviating rollers around the cockpit of the boat. The preload of the spring is in the rest position of the spring absorbed by counterbearings on the starboard side and the port side of the deck.

Referring now to the drawings in detail, the illustrated catamaran consists primarily of two hulls **1, 2** which are rigidly connected by traverses **3** and **4.** The illustrated catamaran furthermore has a shallow cockpit **5** and a mast **6** with a boom **7.** The mast **6** is, by means of a forestay **8,** an aftstay **9,** a port shroud **10,** and a starboard shroud **11,** braced to the deck **12.**

The heel **13** of the mast **6** rests in a shoe **14** and is pivotally journaled in shoe **14** so as to be tiltable about an axis **15** to the port side and to the starboard side.

Closely above the heel **13** the mast **6** carries crosstrees or shroud spreaders and more specifically a port side spreader **16***a* and a starboard spreader **16***b*. Both spreaders are linked to mast **6** while each is pivotable about an axis **17.**

The port side and starboard side shrouds **10, 11** have their lower ends respectively connected to a cable line or tension wire **18, 19** which extends around a fixed roller **20** and a loose roller **21.** The loose roller **21** is connected to the lower end of the port side and starboard side shrouds **10, 11** respectively. The free ends of the cable lines **18, 19** are connected to a spring **22** consisting of rubber strands which are passed around the deviating rollers **23** and around the cockpit **5.** In order to assure that the cable lines **18, 19,** when the mast **6** is tilted toward the lee side will not slacken, the loose rollers **21** are by non-illustrated rubber strops pulled in upward direction.

In rest position, the preload of spring **22** is absorbed by counterbearings **24.** When the mast **6** is in tilted position, the counterbearing **24** on the lee side absorbs the spring force.

From the heel diagram illustrated in FIG. **2,** the theoretical principles of operation for the safety rig according to the invention will become apparent. In this diagram, the angle of heel has been plotted against the heeling moment M resulting from the transverse force of the wind or the righting moment of the boat body. The solid line indicates the course of heeling of a multihull boat, whereas the dot-dash line illustrates the course of heeling of a keeled boat. From the heeling diagram it will be seen that the multi-hull boat has already from the start, due to its construction, a considerably higher initial stability than a keeled boat. The safety rig according to the present invention brings about that the mast **6,** when reaching a limit moment Mg predetermined by the preload of spring **22,** will pivot or tilt whereby the sailing surface exposed to the wind will be decreased. From this point on, the heeling of the boat and of the mast are no longer the same. When the wind force increases further, the heeling of the mast also will increase. The force of the spring **22,** however, can convey to the boat only a limited heeling moment which at the limit of a tilting of the mast **6,** namely, 90° should not exceed the maximum righting moment of the boat. These considerations disregard the fact that in a very rough sea, on one hand the stability of the surface-bound multi-hull boat is reduced, and that on the other hand, additional heeling moments may occur which do not have their origin with the rig. Therefore, it will be expedient to keep the maximum righting moment of the boat always higher than the maximum moment transmittible by the satety rig. Inasmuch as the difference in the heeling moments M_{max} — Mg should remain small, it is necessary that also the working stroke of spring **22** will be kept relatively small with regard to the spring length.

The safety rig is illustrated in FIG. **1** at a slightly inclined angle with regard to the starboard side, in order to clearly illustrate the operation. In this position, the predetermined limit value of the heeling moment Mg as caused by the preload of spring **22** has just been exceeded. The port side shroud **10** has stretched spring **22** by means of the cable line **18** and has lifted spring **22** off the counterbearing **24** on the port side. At the starboard side or lee side, merely the shroud **11** has slackened. As soon as the heeling moment drops again below the limit value Mg, the mast **6** rights itself again.

FIG. **3** illustrates the force-stroke characteristic of the pre-loaded spring **22.** According to this diagram, the transverse force of the wind acting through the sail upon the mast may rise up to a predetermined limit value Kg without the mast **6** yielding. It is only when the limit force Kg has been exceeded that the mast **6** gives toward the lee side.

The safety rig according to the invention is primarily an assurance against capsizing in response to too high wind forces. However, it is also possible that an extremely high sea causes the capsizing of the boat entirely without the aid of the force exerted by the wind. Also, in this instance, the safety rig according to the invention will be able considerably to contribute to righting of the boat body by means without outside assistance. With an elastically yieldable safety rig, the danger of losing mast **6** when the boat capsizes is considerably less than is the case with a rigid rig. If, for instance, a buoyancy body **25** is connected to the head of the mast **6,** the boat will after capsizing be held in the position shown in FIG. **4***a*. If in this position the mast **6** is, by means of a change in the length of the shrouds **10, 11,** pivoted relative to the plane of the deck **12,** it is possible to haul the lower hull **1** inwardly further below the center of gravity of the boat so that eventually a sufficiently large moment for righting the boat will be obtained. The change in the length of the shrouds **10, 11** may, according to the invention, be effected, for instance, by shackling in a lanyard at each side between the loose roller **21** and a ring on the shrouds **10, 11** while a commom line extends from the port lanyard to the cockpit and without interruption back to the starboard lanyard. In this way, the cockpit remains free from superfluous lines or cordage because a shortening of one lanyard is compensated for by the extension of the other lanyard. Furthermore, the lower shroud piece between the ring and the roller **21** must be secured by a bolt which can be released, for instance, by a line

from the cockpit. After capsizing, merely the bolt that is up in the air is released and the line of that lanyard which is in the water is hauled in until the boat has righted itself. By means of the lanyards, the mast **6** can then also be brought back to its original position, even when under the sail. When a sufficient transmission ratio of the lanyards exists, it is possible to carry out the maneuver indicated in FIGS. **4***a* and **4***b*, even with larger boats without the necessity of having to leave the boat after it has capsized.

It is, of course, to be understood that the present invention is, by no means, limited to the particular showing in the drawings, but also comprises any modifications within the scope of the appended claims.

What I claim is:

1. A multi-hull boat, which includes: at least two floating bodies forming the hulls of the boat and parts of the deck traverse means spacing said floating bodies from and connecting them to each other while forming other parts of the deck, a mast pivotally mounted on said deck and being tiltable toward the port side and the starboard side of the boat, starboard and port side shroud means connected to said mast and staying the same relative to said deck, and pre-loaded spring means having the free ends thereof operatively connected to the end portions of said port side and said starboard side shroud means, port side spreader means and starboard spreader means both pivotally connected to said mast near the lower end thereof and having their free ends detachably connected to the lower ends of said starboard and port side shroud means respectively, said spring means being arranged between said spreader means and said deck, first and second cable line means respectively arranged between the ends of said spring means and said spreader means, each of said cable lines comprising a fixed block and a floating roller.

2. A boat according to claim **1,** which includes abutment means mounted on said deck for supporting said spring means and arranged between said cable lines and a portion of said spring means.

3. A boat according to claim **1,** in which said spring means includes rubber strands.

4. A boat according to claim **1,** which includes means associated with said port side and said starboard respectively for respectively inversely varying the length of said port side and said starboard shroud means.

5. A multi-hull boat, which includes: at least two floating bodies forming the hulls of the boat and parts of the deck, traverse means spacing said floating bodies from and connecting them to each other while forming other parts of the deck, a mast pivotally mounted on said deck and being tiltable toward the port side and the starboard side of the boat, starboard and port side shroud means connected to said mast and staying the same relative to said deck, and pre-loaded spring means having the free ends thereof operatively connected to the end portions of said port side and said starboard side shroud means, said spring means including rubber strands, said floating bodies and said traverses defining a cockpit, and said rubber strands extending at the stern around a portion of said cockpit.

6. A multi-hull boat which includes in combination: at least two floating bodies forming the hulls of the boat and parts of the deck, traverse means spacing said floating bodies from and connecting them to each other while forming other parts of the deck, a mast pivotally mounted on said deck and being tiltable toward the port side and the starboard side of the boat, starboard and port side shroud means connected to said mast and staying the same relative to said deck, and pre-loaded spring means having the free ends thereof operatively connected to the end portions of said port side and said starboard side shroud means, the preload of said spring means corresponding to a moment of more than **50%** of the maximum stability of said boat, which includes abutment means mounted on said deck for supporting said spring means and arranged between said cable lines and a portion of said spring means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,820,489 Dated June 28, 1974

Inventor(s) Franz Xaver Wortmann

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet the assignee should read

-- Kortenbach & Rauh Kommanditgesellschaft, Solingen-Weyer, Germany --.

Signed and sealed this 1st day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE 869-930