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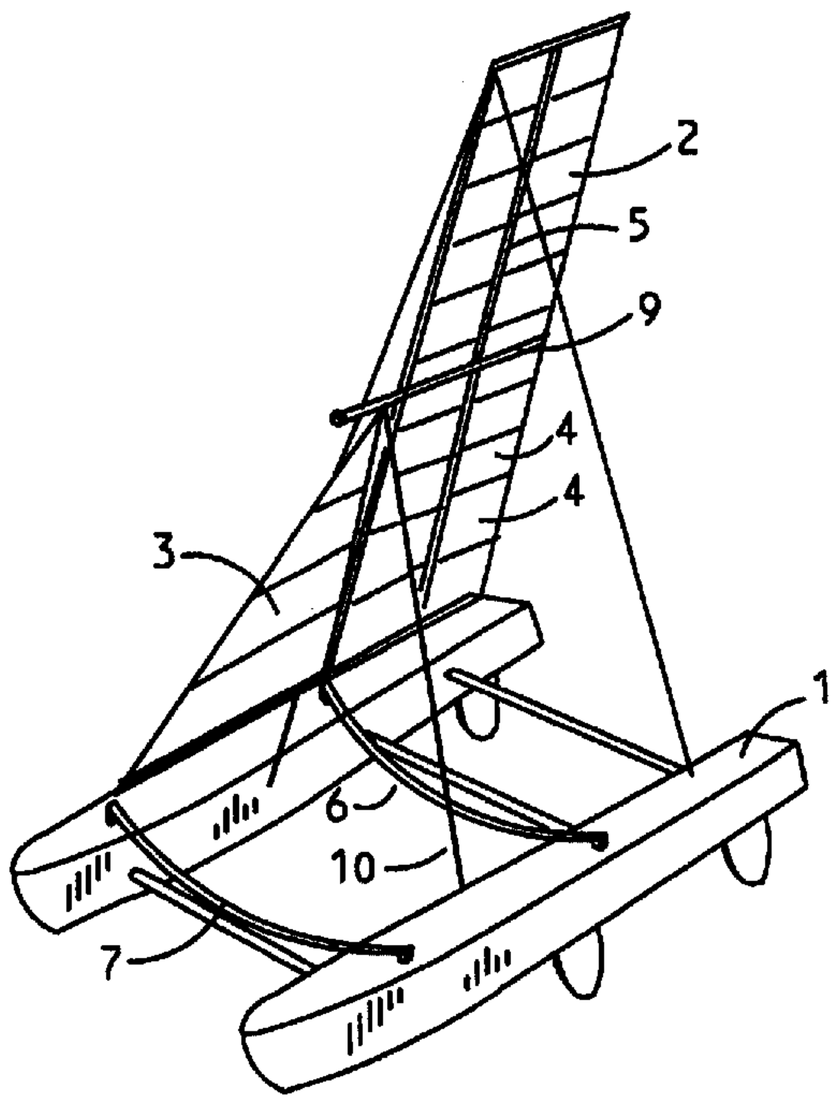
(54) **VOILE CREANT DE LA PORTANCE ET SYSTEME DE VOILES**
(54) **LIFT CREATING SAIL AND SAIL SYSTEM**



(57) L'invention concerne une voile améliorée créant de la portance et un système de voiles dans lequel la grand-voile (2) sensiblement rectangulaire, constituée de panneaux, forme une surface portante efficace du point de vue aérodynamique, soutenue vers son centre par un pivot qui lui permet de pivoter dans trois dimensions. La grande voile (2) peut être inclinée à bâbord / à tribord, tournée autour de l'axe de lacet et inclinée en avant et en arrière pour créer de la portance et minimiser la traînée. Un foc (3), proposé en option, peut suivre les mouvements de la grand-voile et également créer de la portance. La grand-voile (2) et le foc (3) peuvent être réglés et positionnés en trois dimensions pour arriver à une portance maximale, minimiser la traînée et obtenir un système stable. Grâce à ce système de voiles, la vitesse du bateau augmente de 15-25 %.

(57) An improved lift creating sail and sail system where a substantially rectangular mainsail (2) made up of panels forms an aerodynamically efficient airfoil that is supported at approximately its center on a pivot so that is has three degrees of freedom. The mainsail can be tilted at hartships, rotated along a yaw axis, and tilted for and aft to create lift and minimum drag. An optional jib sail (3) that can track the motion of the mainsail also produces lift. The mainsail (2) and jib sail (3) can be trimmed and positioned along three degrees of freedom to obtain maximum lift and minimum drag as well as a stable system. The effect of this sail system is to increase the speed of the boat by 15-25 %.

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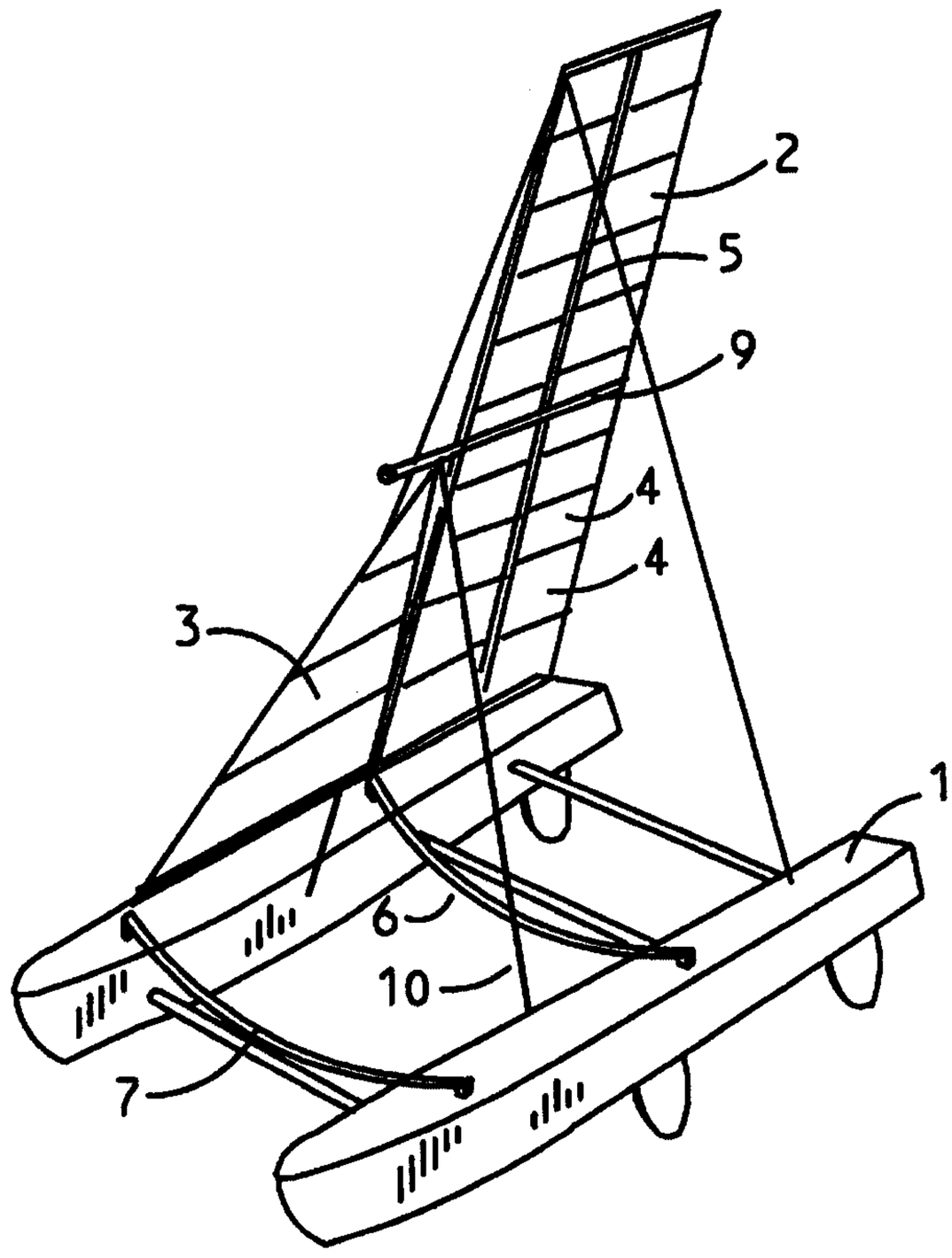
(54) Title: LIFT CREATING SAIL AND SAIL SYSTEM

(57) Abstract

An improved lift creating sail and sail system where a substantially rectangular mainsail (2) made up of panels forms an aerodynamically efficient airfoil that is supported at approximately its center on a pivot so that is has three degrees of freedom. The mainsail can be tilted at hartships, rotated along a yaw axis, and tilted for and aft to create lift and minimum drag. An optional jib sail (3) that can track the motion of the mainsail also produces lift. The mainsail (2) and jib sail (3) can be trimmed and positioned along three degrees of freedom to obtain maximum lift and minimum drag as well as a stable system. The effect of this sail system is to increase the speed of the boat by 15–25 %.



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Description

LIFT CREATING SAIL AND SAIL SYSTEM

Technical Field

This invention relates generally to the field of sails and sail boats and more particularly to a mainsail that can create lift and a sail system of a mainsail and a jib sail that together create lift and increase the speed of a sailboat by 15-25%.

Background Art

A sailboat is propelled by wind impinging on a sail to create thrust (a forward force vector). A typical sail however, also creates drag (an aftward force vector) tending to cancel thrust. In addition, the boat's hull creates considerable drag as it passes through the water. The magnitude of the total drag force is proportional to boat's velocity and is related to the amount of the hull under water, the exact shape of the hull, the size and shape of the sail, and other factors. If a sail system can create lift (an upward force vector) as well as thrust and drag, the hull is pulled more out of the water (called a reduction in heeling). This effect can considerably reduce drag caused by the hull. Since hull drag is the major component of drag, the speed of the boat can be substantially increased. Also, if airflow over the sail can be optimized, sail drag is decreased as well resulting in further increases in speed.

Prior art systems for achieving lift on a sailboat have operated off of a single mainsail attached to a mast that could be tilted such that the top of the sail moved windward of the centerline of the boat. The idea was to incline a conventional sail athwartship so that the top of the sail moves into the wind producing lift as well as thrust. However, simply tilting the sail causes an undesirable side effect called "lee helm." This is a tendency for the boat to try to turn away from the wind requiring the continuous use of rudder to maintain a heading. This use of rudder causes extra drag slowing the boat. "Lee

helm" is actually caused by a resultant force moment created by the center of pressure in the sail being windward of the center-line of the boat. In order to counter "lee helm" some prior art systems tilt the sail aft as well as athwartship to achieve a canceling moment.

Prior art systems all attach the base of the mast to either a flexible joint on the centerline or to a straight or curved track running athartship. This has the disadvantage of not being able to position the sail at an optimum angle with respect to the wind for maximum lift and minimum drag. Prior art systems also use conventional triangular sails which are also not optimum for producing maximum lift. Finally, no attempt has been made in prior art systems to make use of a jib sail that works in harmony with the mainsail and moves optimally with the mainsail to also produce lift.

Disclosure of the Invention

The invention relates to an improved lift creating sail and sail system. It contains a mainsail and a jib sail. Both sails can be tilted to produce lift. The mainsail is an aerodynamically efficient airfoil that can be made from a set of panels. The mainsail is normally mounted on a pivot that can be located near the its center. The pivot is normally attached to an A-frame in such a way that it can move about three degrees of freedom. This way the mainsail can be tilted athartships (port and starboard); it can be rotated along the yaw axis; and it can be tilted fore and aft. The mainsail can be of generally rectangular shape, or any other convenient shape, and can be furled by either rolling it up or gathering it in. The various axes of tilt and rotation are totally general whereby the sail can be tilted or yawed to any angle or orientation with respect to the boat and the wind. In this manner, the generally rectangular sail can be used so that its length is generally up and down or it can be tilted so that its length is substantially horizontal as a square sail. It can, at the same time, be yawed to any angle and tilted athartships to any angle. The mainsail can be mounted so that its

weight rests on the pivot and A-frame from its center. There is generally no mast and no weight supported by the base of the mainsail.

The system also has a jib sail that also tilts into the wind to generate additional lift and to compensate for any lee helm effect. This jib can track the athartship tilt of the mainsail, or it can be positioned at a different angle for optimum trim and efficiency. The total flexibility of tilt angles for both the mainsail and the job, coupled with the use of a lift creating jib and the ability to furl, yields a sail system that creates optimum lift (leading to minimum total drag on the boat) for any wind direction, velocity, or condition.

Brief Description of the Drawings

Figure 1 shows a perspective view of a type of sailboat equipped with an embodiment of the present invention.

Figure 2 shows a top view and a front view of at type of sailboat equipped with an embodiment of the present invention.

Figure 3 shows a perspective view of an embodiment of a mainsail.

Figure 4 shows a side view and a top view of an embodiment of a mainsail.

Figure 5 shows an embodiment of the mainsail panels creating an air slot.

Figure 6 shows how the present invention is operated in reach or tack (wind athartships or forward).

Figure 7 shows how the present invention is operated in run (wind aft).

Figure 8 shows an optional coupling of the mainsail and jib sail.

Best Mode of Carrying Out the Invention

Figures 1 shows a perspective view of a type of sailboat with two hulls. The invention is equally suited for use on a monohull boat or any other combination of hulls. In Figure 1, each of the hulls (1) is elongated with a major axis defining a fore and aft direction along the boat. The mainsail (2) in this embodiment is substantially rectangular; however, the mainsail can have any other convenient shape. The jib sail (3) is substantially triangular in this embodiment, and can be mounted forward of the mainsail (2). The jib sail can have any other convenient shape.

The mainsail (2) shown in figure 1 can be made of several panels (4) of sail material, or it can be a continuous sail. The panels (4) are held together using spars (5) or trusses, or any other construction means to form a semi-rigid frame.

The mainsail (2) is normally mounted at a pivot (8) that allows it three degrees of freedom. This means that the mainsail (2) can be tilted athartships and fore and aft, and it can be yawed to any angle with respect to the centerline of the boat. A truss or cross spar (9) can be located at the center of the mainsail (2), and one end of this truss (9) is normally attached to the pivot point ()8. The pivot (8) is firmly attached to an A-frame (10) that is normally rigidly attached to the hull(s) (1). The entire weight of the mainsail (2) can rest on this pivot (8). The base of the mainsail is not normally attached to the hull. The A-frame (10) thus supports the mainsail (2).

An optional track or traveler (6) is located below the pivot (8) at the level of the top of the hull(s) (1). This track is generally not attached to the base of the mainsail. In fact, the base of the mainsail (2) can move substantially away from this

track (6) when the mainsail is tilted fore and aft. The optional track (6) allows the tilt motion or position of the mainsail (2) to be cross coupled to the jib sail (3). The forward foot of the jib sail (3) can be attached to a second track (7) that is also part of the cross coupling of motion from the mainsail to the jib sail. The actual cross coupling of position can be accomplished with lines or any other means that will couple motion from one of the sails to the other. The top or head of the jib sail is normally attached to the pivot point (8). Thus, the fore foot of the jib sail moves in the same direction as the fore foot of the mainsail. The optional method of coupling the motion of the two sails in this embodiment can be through cross-rigged lines between the mainsail track or traveler (6) and fore foot of the jib sail on its track (7).

Figure 2A shows a top view and Figure 2B shows a front view of the invention of figure 1. In figures 2A and 2B, the hull (1), mainsail (2), jib sail (3) and the jib sail track (7) can be seen. The position of the mainsail track (6) is also shown. In Figures 2A and 2B, the athartship tilt of the mainsail (2) can also be seen.

Figure 3 shows that the mainsail can be made up from a plurality of panels (4) of sail material on a frame made of longitudinal spars (5). The horizontal truss (9) can be seen attached to a cross truss (11) at the center of the mainsail. Either a truss or a cross spar can be used; however, a truss has been found to be stronger.

Figure 4A is a side view and Figure 4B is a top view of the mainsail of figure 3. Here the structure of the truss (11) can be more clearly seen. Also in figures 4A and 4B, two leading edge foils (12) can be seen. These allow the individual panels of the mainsail to rotate about the longitudinal spar. The sail area can be varied by furling in and out the sail which can be rolled around the longitudinal spar. In an alternate embodiment of the present invention, the sail area can be varied by sliding the sail towards the cross spar. This allows the use of pliable

battens rather than reinforced seams.

Figure 5 shows an embodiment of the leading edge foil that would vary the sail area by sliding the sail towards the cross spar. In figure 5, the vertical spars (5) are seen with the sail panels attached through leading edge foils (12). The leading edge foils (12) freely rotate about the spars (5) allowing the panel (4) to take various positions with respect to the wind. An alternate position is shown by a broken line (14) in figure 5. Between the fore and aft panels of the mainsail is an air slot (13). This optional feature allows a tremendous increase in the efficiency of the mainsail by acting as a boundary layer control device such as might be found on the wing of a high performance aircraft. By keeping the boundary layer of the airflow close to the surface of the panel, drag caused by the sail itself is tremendously reduced.

Figure 6 shows a possible orientation of the mainsail and jib sail in run (run is a situation where the wind is aft of the boat). The mainsail can be tilted along three degrees of freedom to achieve maximum lift and thrust. The forefoot of the jib sail tracks the athartship tilt of the mainsail, and can be trimmed for the exact heading with respect to the wind and wind and sea conditions. Of course, the system will be adjusted to different angles and trim depending on the exact wind direction (directly astern as opposed to an angle off the beam).

Figure 7 shows a possible orientation of the mainsail and jib sail in reach or tack (reach is when the wind is athartships, while tack is when the wind is at an angle off the bow - tacking is the art of taking a sailboat into the wind by alternately changing heading with respect to the wind from port bow to starboard bow, etc.). Again, the system will be adjusted to different angles depending on the exact wind direction and on conditions. The angle will be changed on each tack if an attempt is being made to keep an average heading into the wind.

Figure 8A and 8B show how the jib is optionally made to

track the athwartship motion of the mainsail. Under the mainsail is a curved rocker shaped track (6) running athwartship at approximately halfway fore and aft. On this track (6) is a carriage (17) that slides alone it. This carriage (17) is attached through lines to the mainsail (2) at the front spar. These lines are attached to the top and bottom of the mainsail (2). On the bow is another curved track (7); however this track (7) points forward rather than down. On this track is another carriage (16) that is directly attached to the front of the jib. The two carriages (16), (17) are coupled by a rigged line (15) that is crossed between a set of forward pulleys (18) and aft pulleys (19). These pulleys (18), (19) are directly attached to the hulls (1) adjacent to the forward and aft tracks (7), (6). In this manner, the mainsail can be coupled to the jib sail in terms of athwartship motion. When properly rigged, the bottom of the mainsail follows the front or forefoot of the jib. If the jib moves right or starboard, so does the bottom of the mainsail. It is important to note that the bottom of the mainsail (2) is not tightly connected to the carriage (17) on the amidships track (6), but rather is loosely connected through a series of lines. This allows the mainsail (2) to freely tilt fore and aft and still maintain the athwartship coupling to the jib. A line on the aft of the mainsail is used to trim it.

Sailing a boat using the present invention consists of adjusting the yaw of the mainsail and jib sail, and then adjusting the amount of sail trim in each sail. The degree of yaw of the mainsail (which can control the amount of yaw of the jib sail) can be controlled by adjusting the position of the forefoot of the mainsail. This can be connected to its track by a traveler and fixed with lines an cleats. The top of the mainsail can be simultaneously braced by adjusting lines attached to the head of the longitudinal spar. Sail trim of the mainsail can be adjusted by lines attached to the aft of the mainsail at the center, and bottom cross spars and secured by cleats. Sail trim of the jib can be adjusted by lines attached to the aft foot of the jib and fastened to the traveler at the fore foot of the mainsail. To reduce the amount of wind in each sail, one can

loosen the line affecting sail trim (spill the wind), or turn the boat into the wind (luff the sails).

Industrial Applicability

The present invention is very useful in the sailboat industry. It is a novel way of increasing the speed of a sailboat by 15-25 percent by causing the mainsail and jib sail to product lift. This allows boats to race or to sail normally much faster than would otherwise be possible. There is a tremendous demand worldwide for faster, more efficient, sailboats.

Claims

1. A lift-creating sail system that increases speed of a sailboat comprising a boat with at least one hull;

a substantially rectangular mainsail supported at its middle from an A-frame attached to said hull, said mainsail free to move independently along each of three axes;

a substantially triangular jib sail having an active area, said jib sail coupled to said mainsail so that said jib sail tracks athartship motion of said mainsail;

adjustment of said sails to achieve maximum lift and thrust and minimum drag in any wind condition by tilting said mainsail athartships, said jib sail tracking said mainsail; tilting said mainsail fore or aft; yawing said mainsail and said jib sail independently to achieve optimum performance of said boat.

2. The lift-creating sail system according to claim 1 further comprising changing active wind area of said mainsail to control said lift and said drag.

3. The lift-creating sail system according to claim 1 wherein said mainsail contains a plurality of panels attached to a set of spars, each of said panels having an active area.

4. The lift-creating sail system according to claim 3 further comprising a furling system whereby the active area of each of said panels can be varied.

5. The lift-creating sail system according to claim 3 whereby the active area of said jib sail can be varied by furling.

6. The lift-creating sail system according to claim 1 whereby said jib sail is coupled to said mainsail so that yaw of said jib sail is similar to yaw of said mainsail.

7. The lift-creating sail system according to claim 3 further comprising an air-gap between fore and aft panels of said main-sail for airflow optimization.

8. A sail system for a sailboat that creates lift as well as thrust and drag, the improvement comprising, a substantially rectangular mainsail, and a substantially triangular jib sail; the mainsail made of panels with an air-gap located between fore and aft panels to optimize airflow across the mainsail, the mainsail attached near its midpoint to an A-frame which itself is firmly attached to the boat; the mainsail attached in a manner that allows it to pivot with three degrees of freedom being able to be set to create optimum lift and thrust for any wind; the jib sail mounted forward of the mainsail, its top attached to the A-frame where the mainsail is attached, the jib sail being coupled to the mainsail so that it tracks athartship motion of the mainsail also creating lift and thrust, the jib sail and the mainsail both being ajustably free to assume any yaw angle with respect to the boat, the mainsail also being free to tilt fore and aft to any angle with respect to the boat, the sail system being trimmed to capture a desired amount of wind creating optimum lift and thrust for wind and sea conditions and desired boat speed.

9. The sail system according to claim 8 further comprising a set of longitudinal and cross spars holding the panels of the main-sail in place.

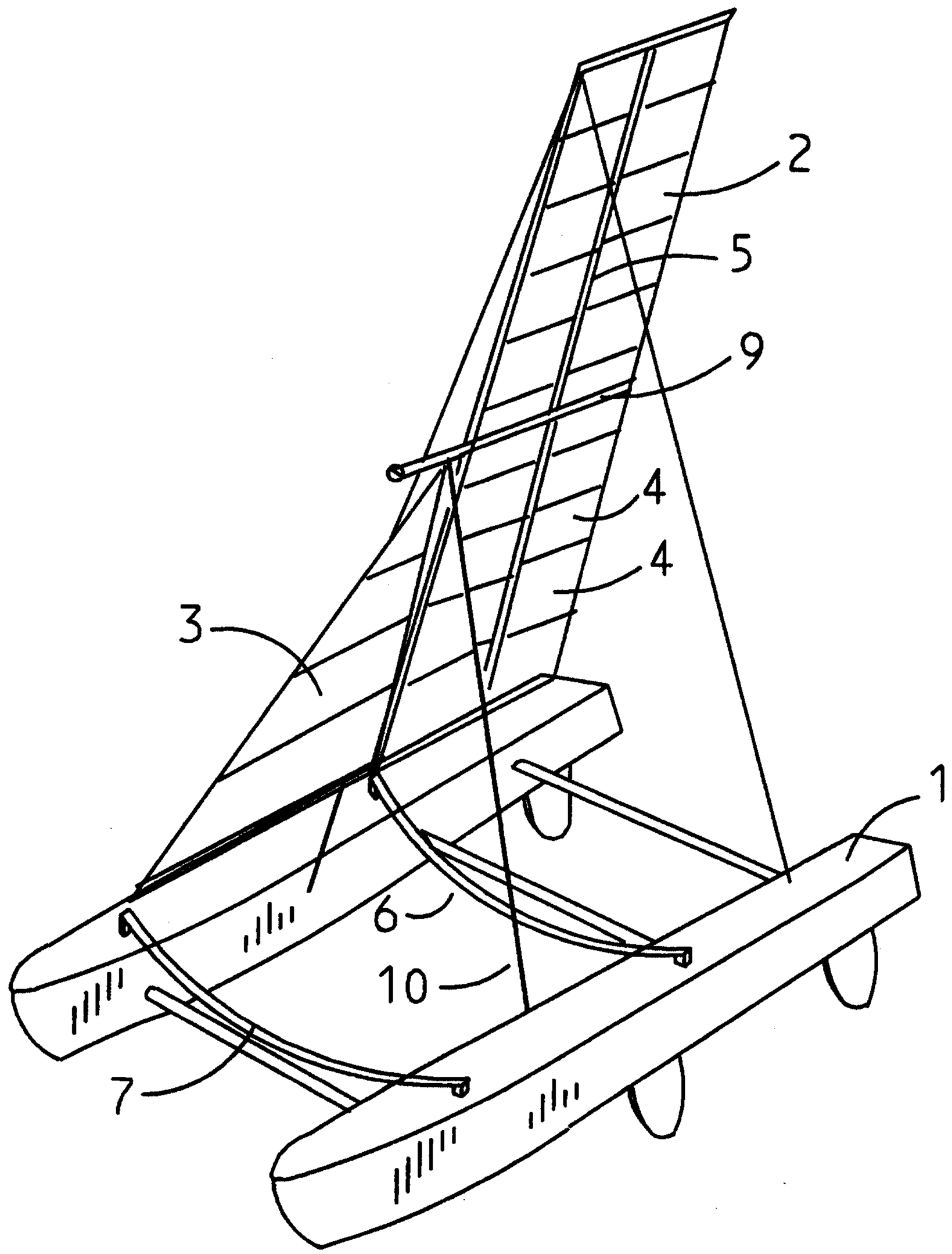

FIG. 1

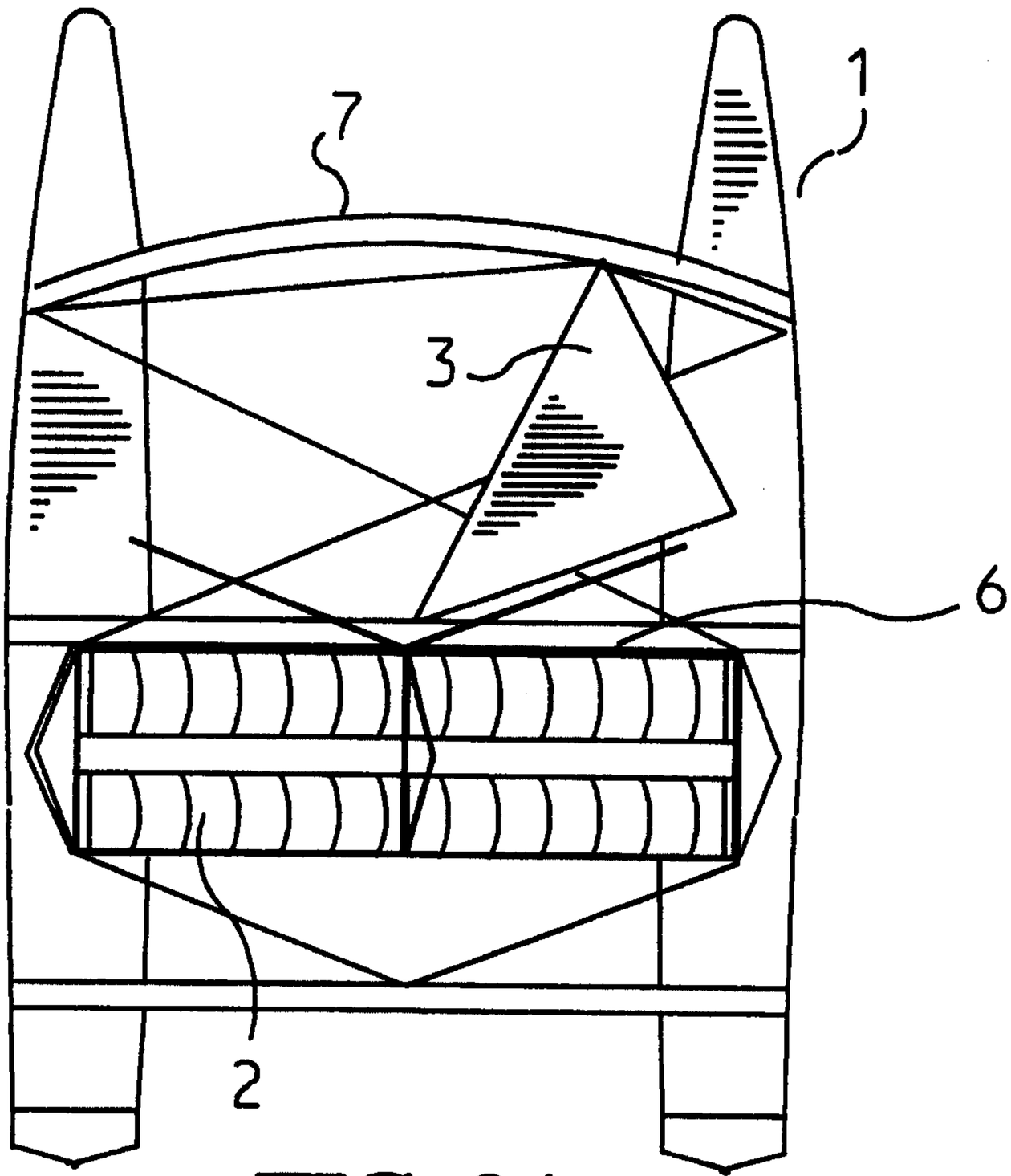

FIG. 2A

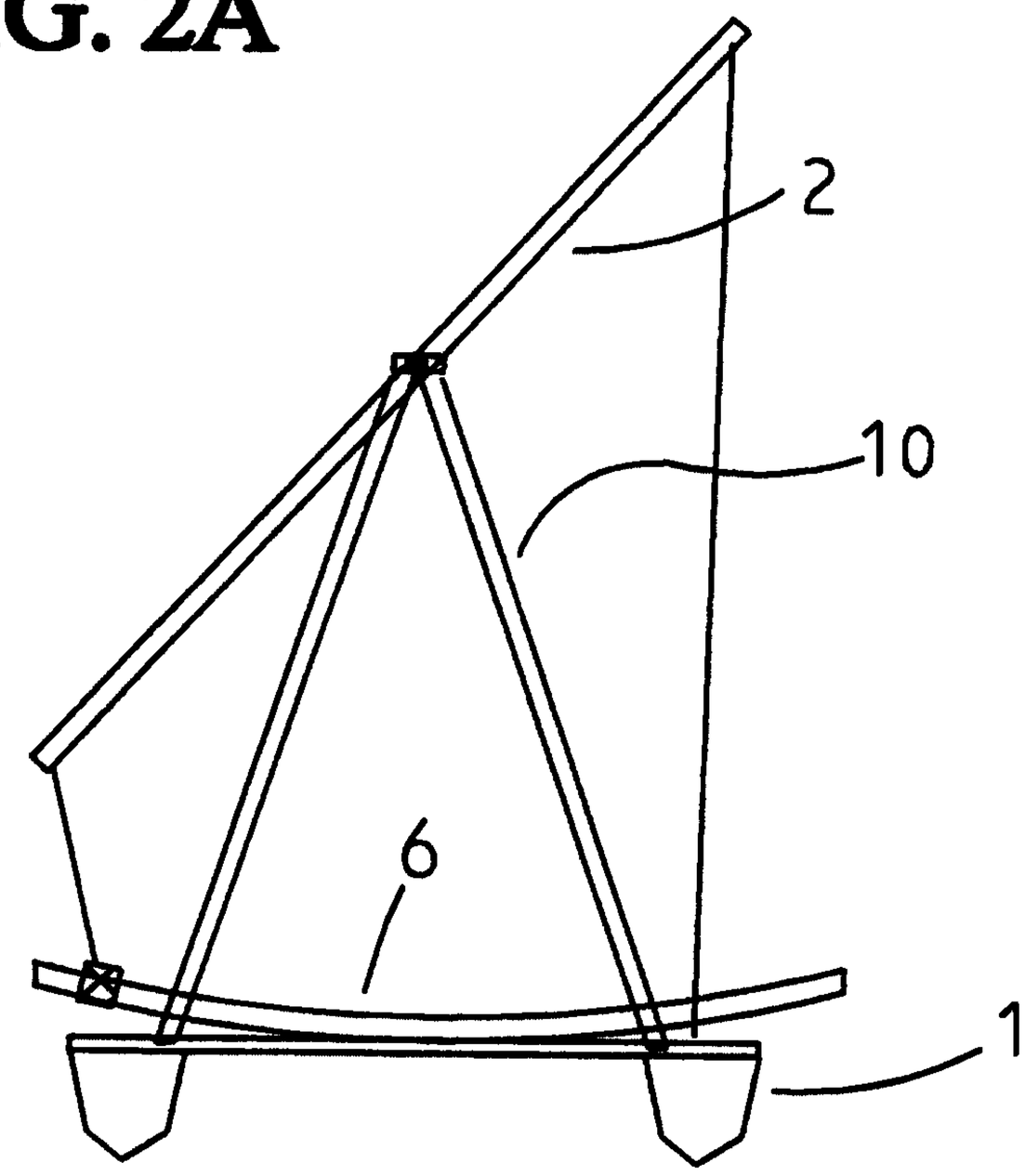

FIG. 2B

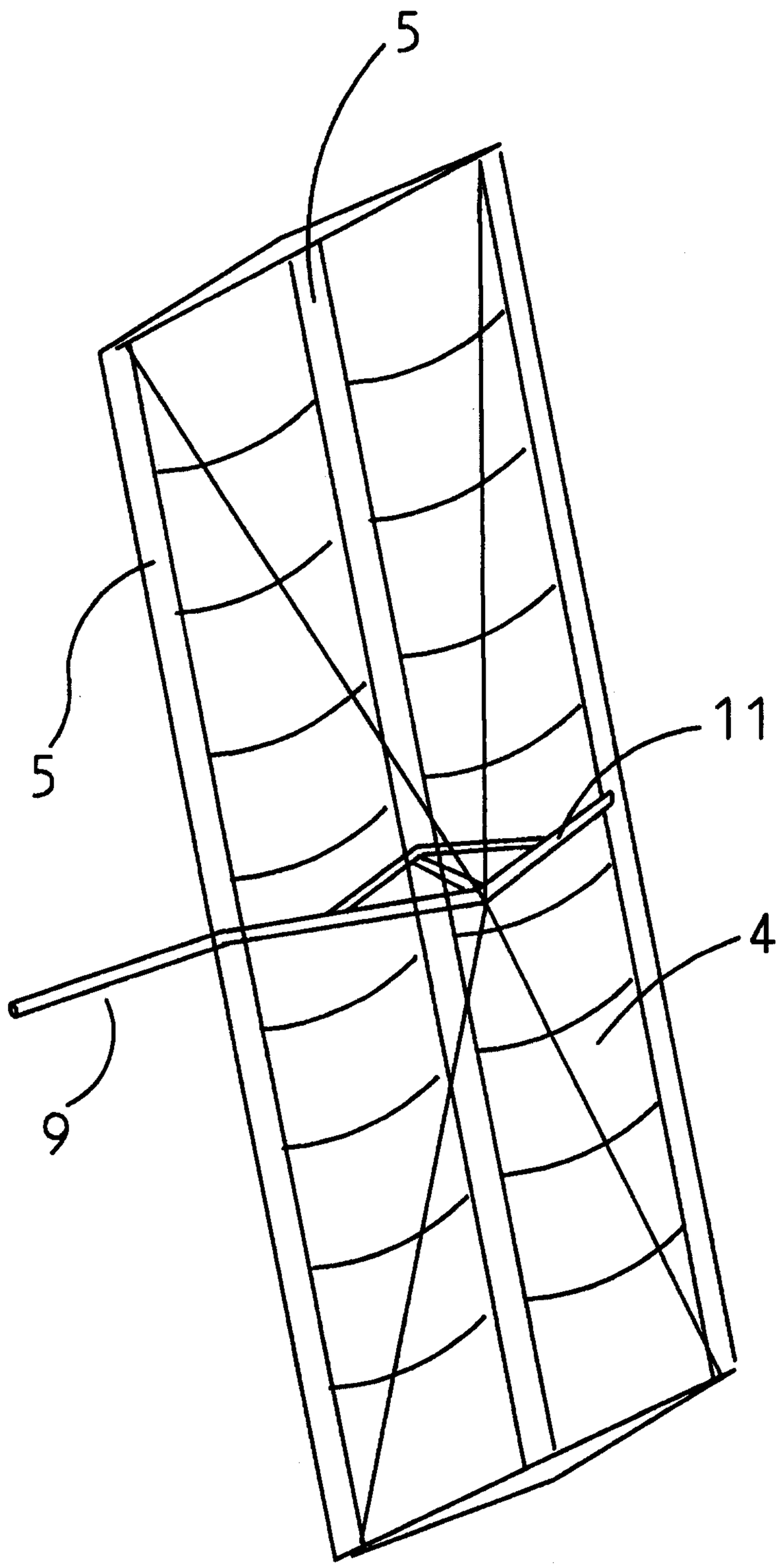

FIG. 3

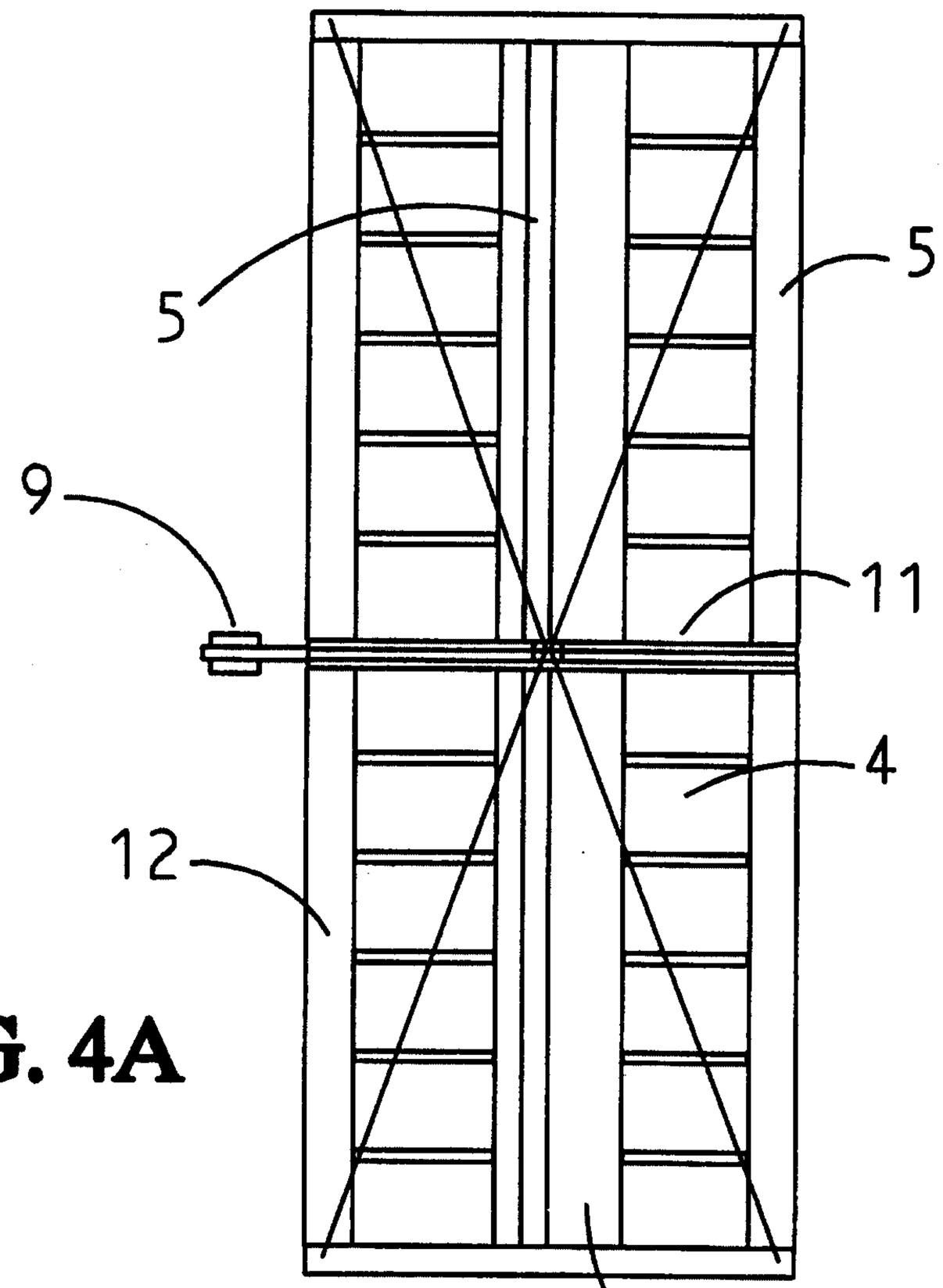

FIG. 4A

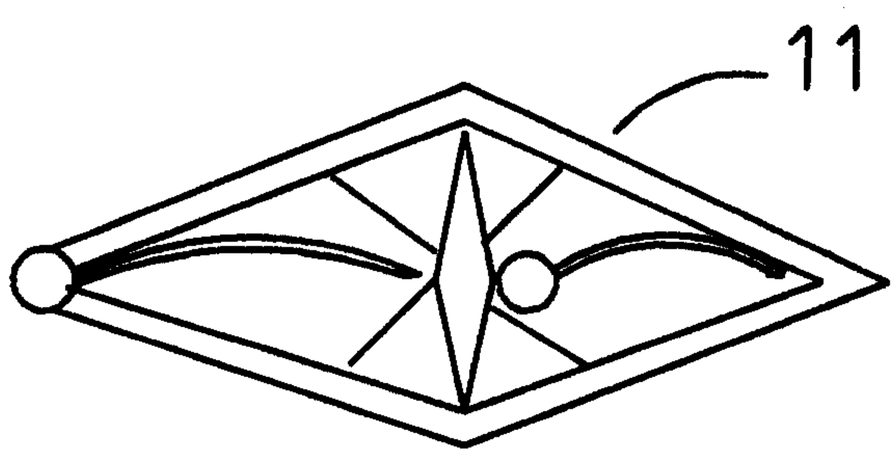

FIG. 4B

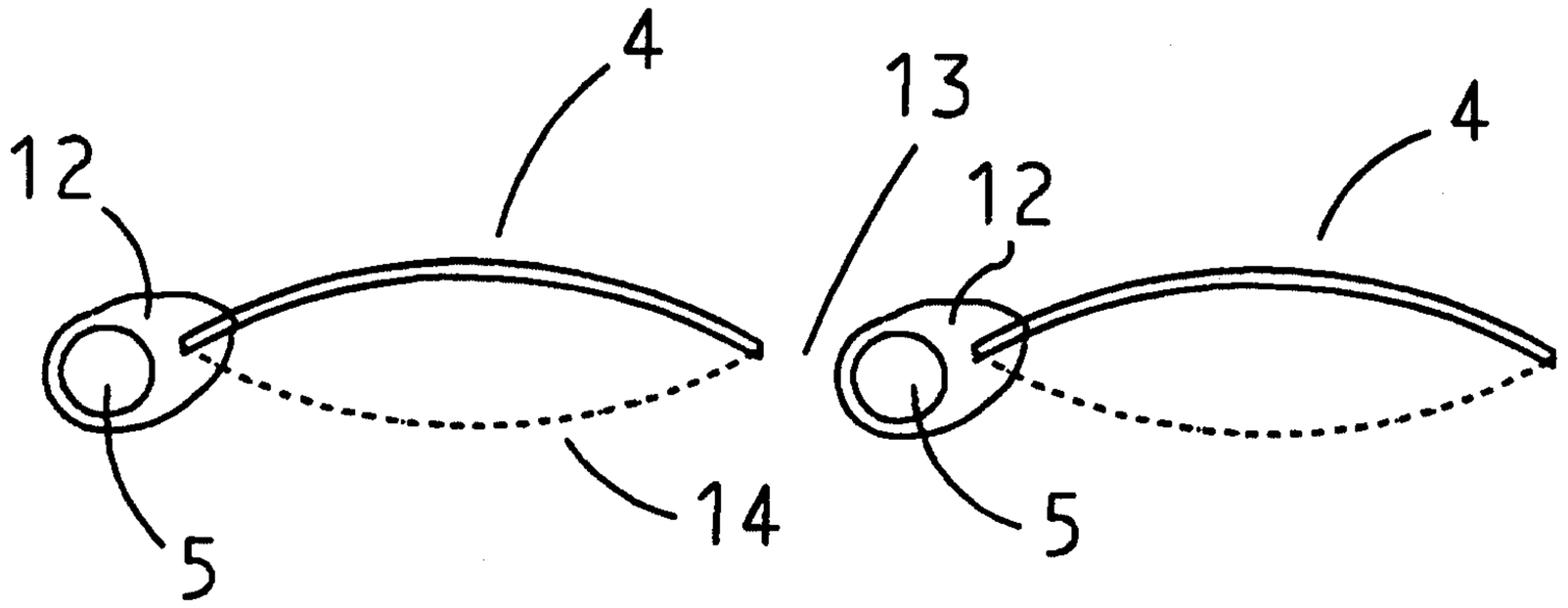

FIG. 5A

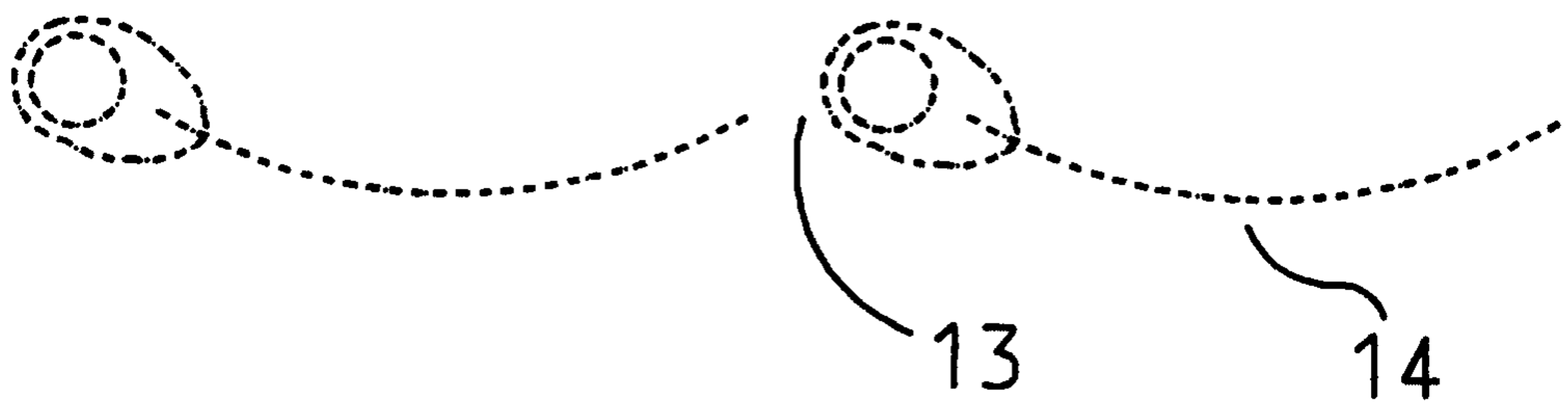

FIG. 5B

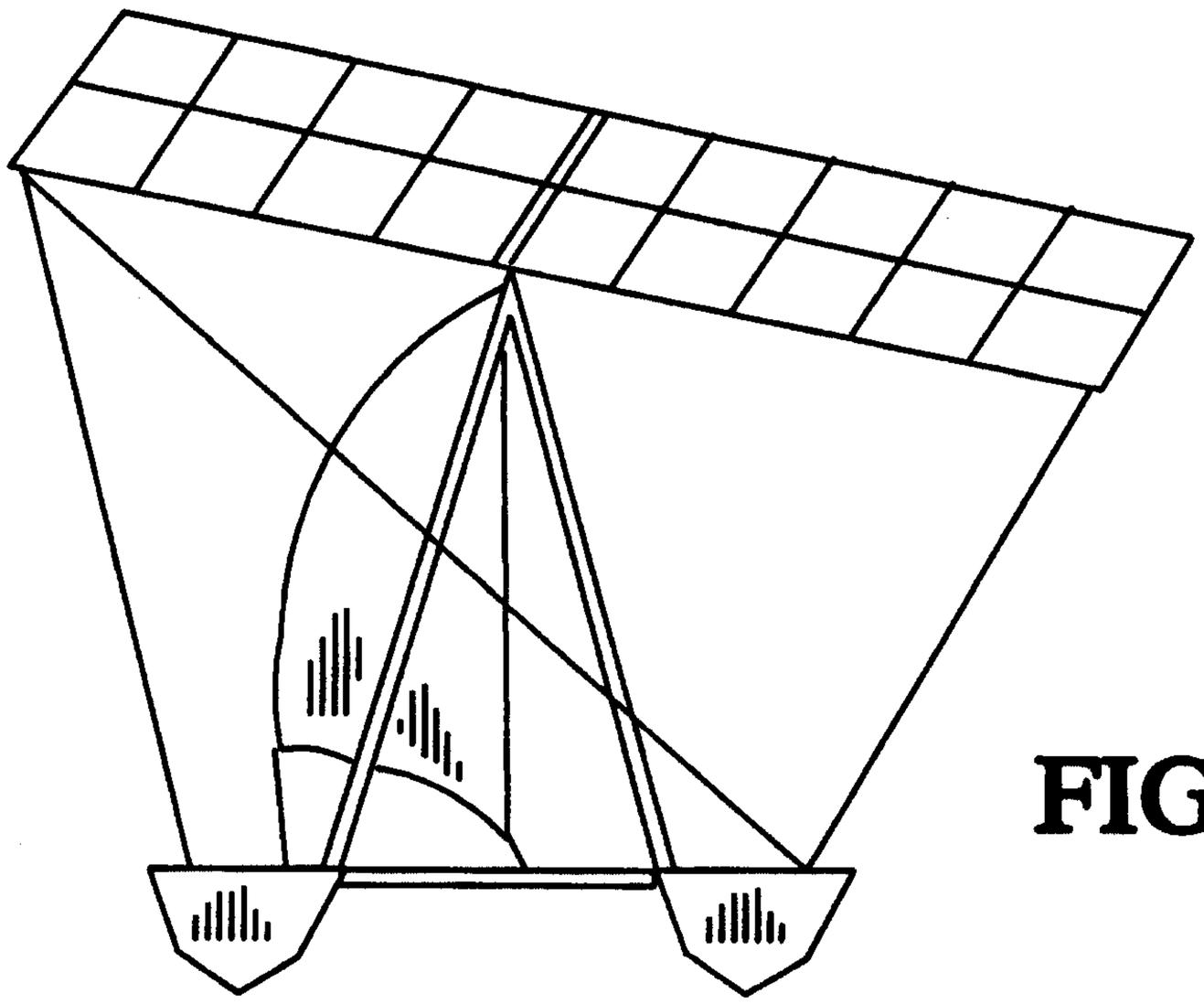

FIG. 6A

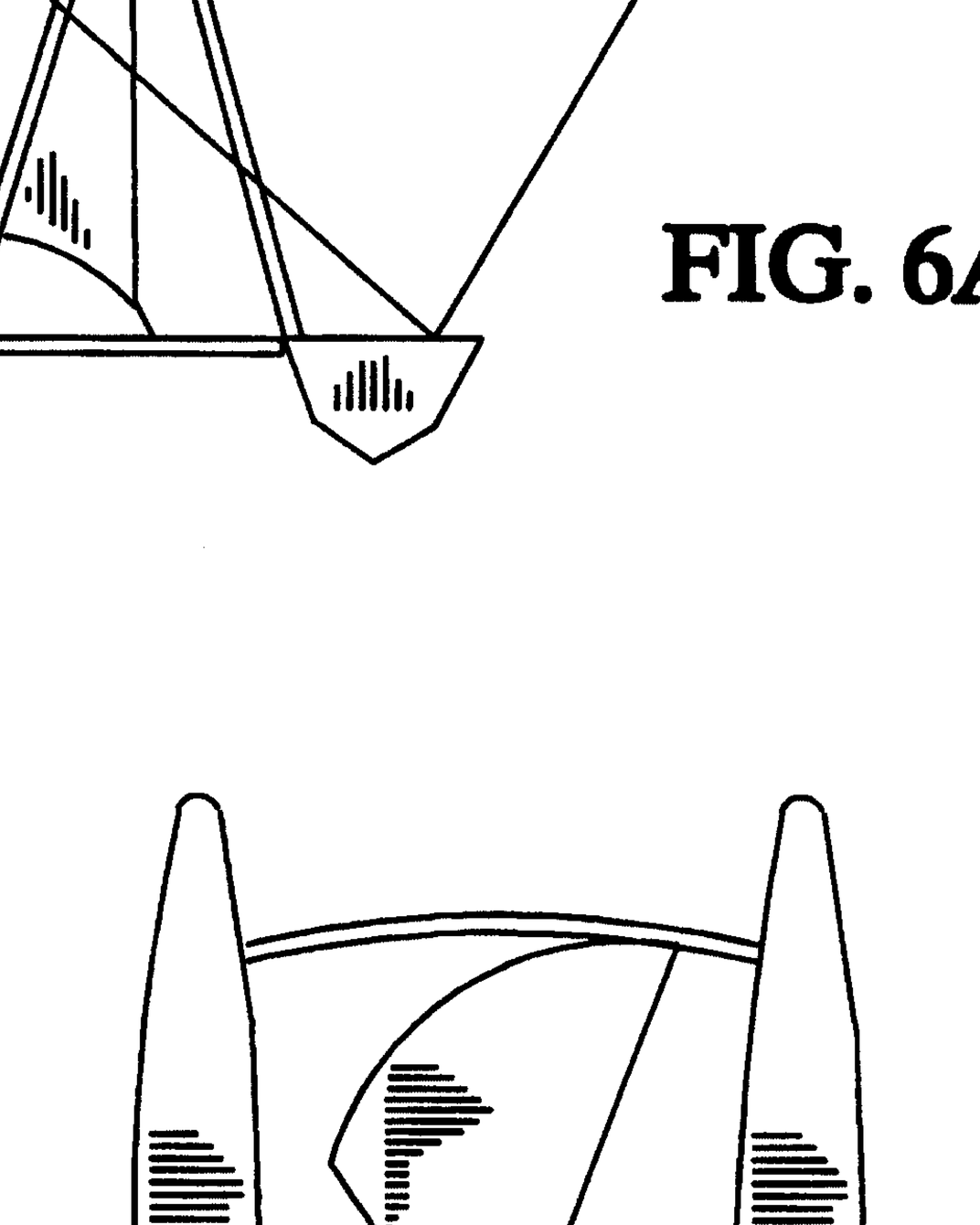

FIG. 6B

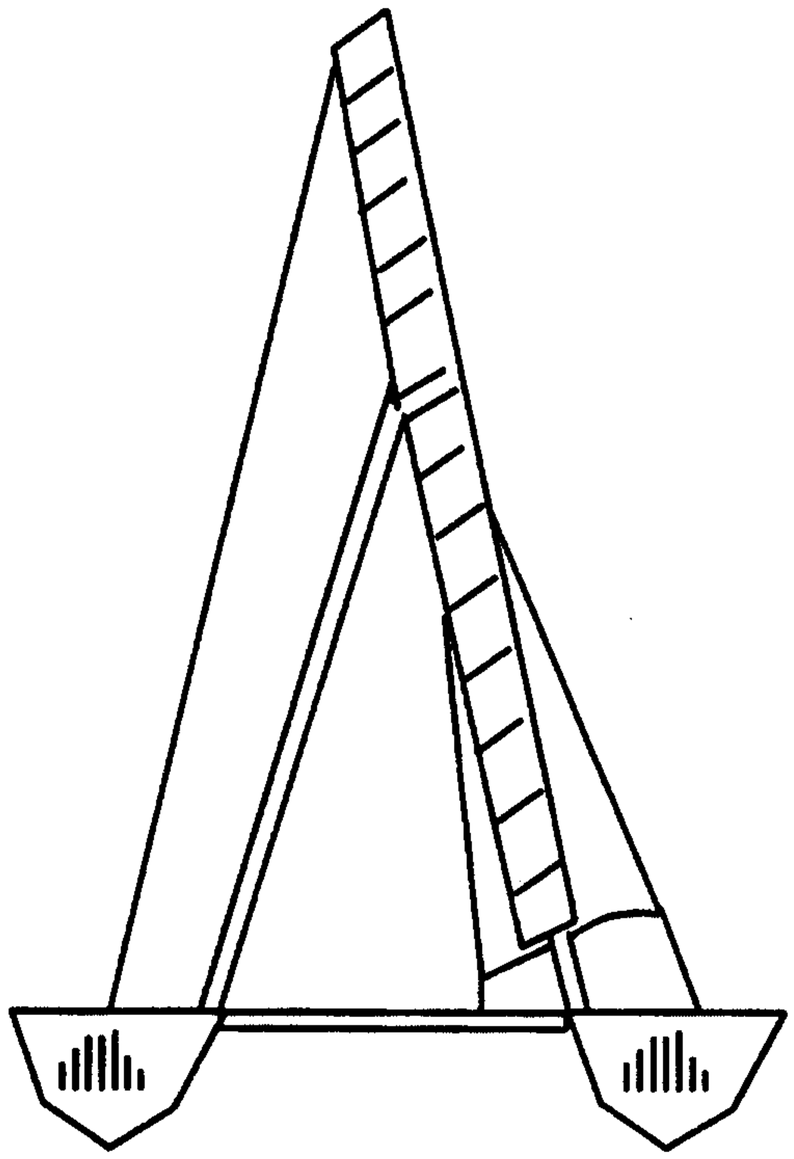

FIG. 7A

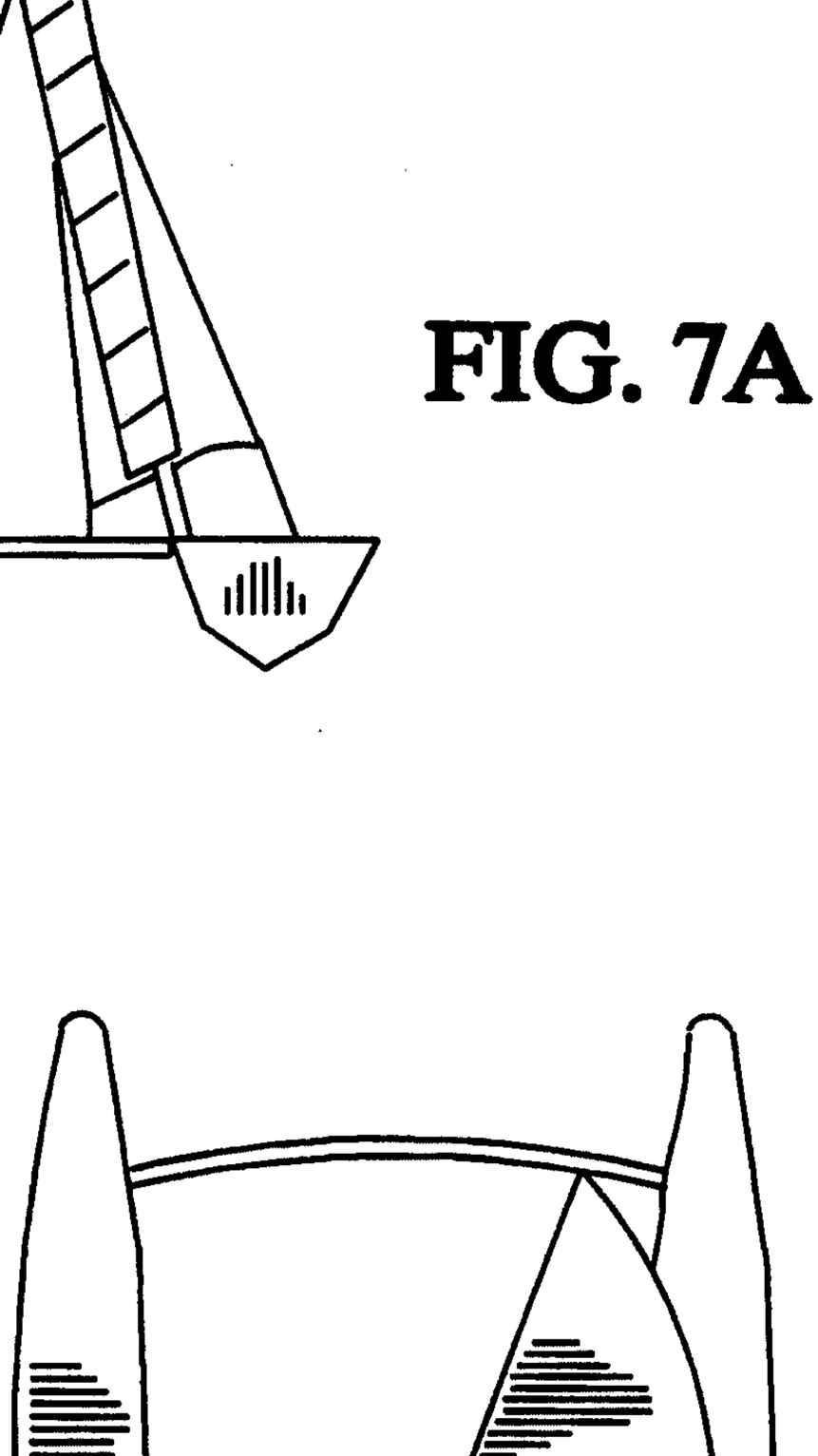

FIG. 7B

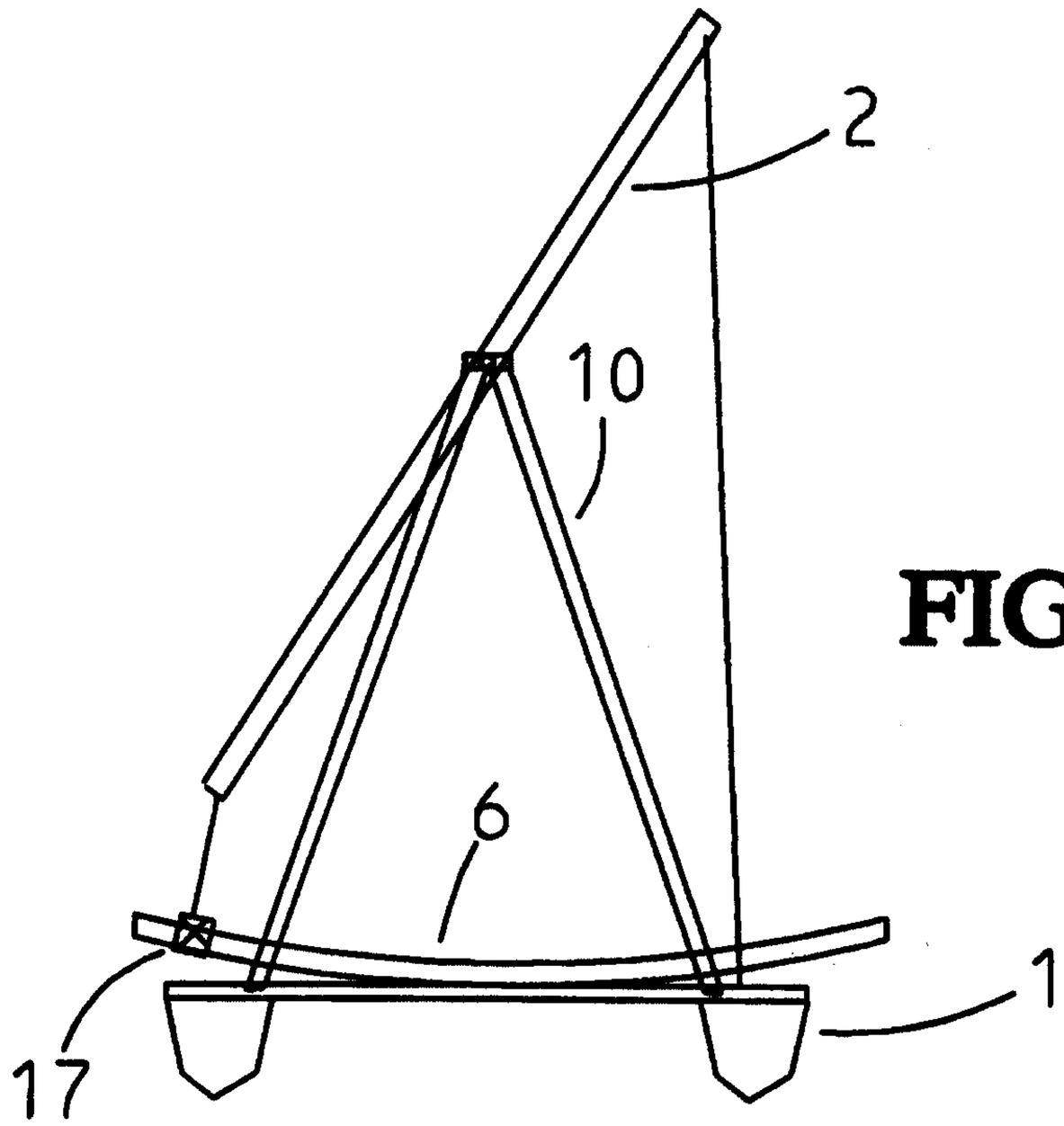

FIG. 8A

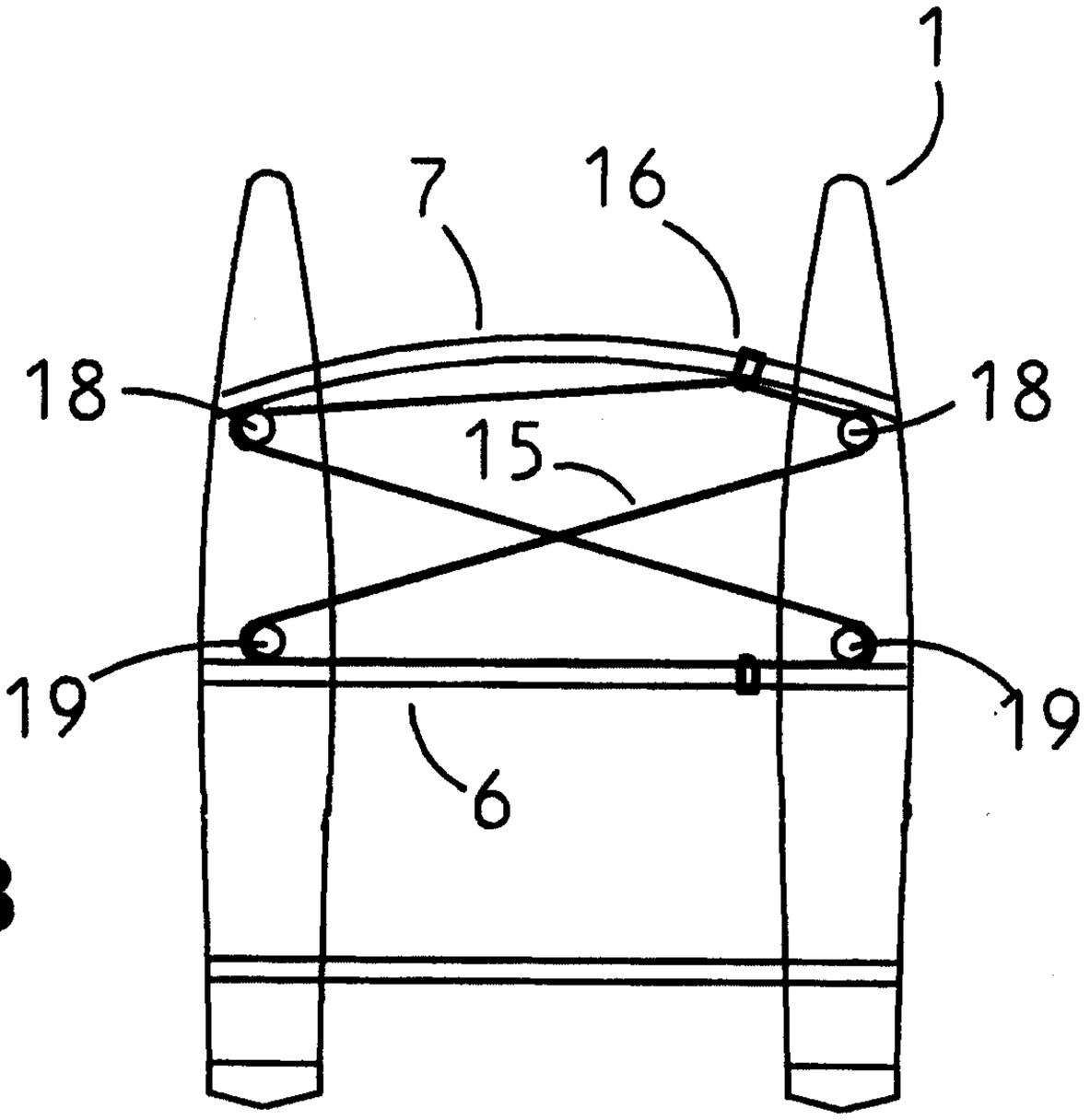

FIG. 8B