# METHOD OF INTERCEPTING AND YAWING A SAILING VESSEL WITH EXTERNAL PROPULSION MEANS

## TECHNICAL FIELD

This invention relates to a method of intercepting a sailing vessel and yawing it to force a change in direction of sail. It is directed to regaining control of sail direction of an errant or malfunctioned vessel.

## BACKGROUND ART

In post-September 11, 2001 terrorist attacks on New York City which has heightened fears of man-made disasters and terrorist acts, it has been envisaged that ships and large vessels may be used to attack and destroy harbours and seafront installations such as oil refineries, chemical plants, etc. or another sea-borne object such as oil rig or a passenger ship. As some of the ships and vessels may be carrying flammable or inflammable materials, such as crude oil or refined petroleum products, they might be hijacked by terrorists and set on course to collide with these targets of attack. If the vessel is large enough, its massive moving mass may create a momentum large enough to cause destruction by sheer collision onto a target.

Accordingly, it is imperative that methods are available for preventing such attacks and that the errant or malfunctioning vessel be quickly controlled and yawed to avoid colliding with the targets or being used as a weapon of massive destruction.

U.S. Patent No. 6,591,774 discloses a barrier system for protecting ships and harbours from attack by vessels. The barrier system is constructed around the ships or habour to be defended. The barrier may either be floating on the surface above and/or beneath the surface of the water. When a vessel attempts to force its way through the barrier, the barrier uses the momentum of the vessel against itself by using the forward momentum of the attacking vessel in such a manner as to divert, impede, stop, damage or destroy the vessel. This system however may only be suitable for stopping a small attacking vessel and may not be suitable for arresting large shipping vessels.

US Patent No. 6,413,128 discloses a device for changing the direction of travel of a watercraft. The device includes a gondola-like underwater housing having a container favourable in terms of flow outside the hull by the watercraft, and is connected to the hull of the watercraft by a shaft. The change in direction of travel of the watercraft is brought about by a pivoting motor acting on the shaft, and the use of high energy fluid jets in the gondola-like structure. The latter is a permanent device attached to the watercraft to enhance steering at low noise.

US Patent No. 6,698,374 discloses a tugboat design with a towing installation having a 360° turning to steer and guide a large shipping vessel. There is no disclosure on means of attaching the tow rope to a vessel to be towed, especially a large vessel such as a hijacked one, as access to the vessel would be denied.

It is therefore desirable that a method be provided to effectively intercept an errant or malfunctioned vessel from crashing into a seaside installation or sea-borne target of terrorist attacks or mishaps resulting from vessel malfunction. As some of these vessels may be of a huge size and tonnage, and carrying flammable cargo such as petroleum products, it is essential that any such method is effective in changing the course of direction of the vessel as quickly and in the shortest distance as possible. Preferably, such methods are able to achieve a turning radius of 2 km.

Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material forms a part of the prior art base or the common general knowledge in the relevant art in Singapore or elsewhere on or before the priority date of the disclosure and claims herein. All statements as to the date or representation as to the contents of these documents is based on the information available to the applicant and does not constitute any admission as to the correctness of the dates or contents of these documents.

**SUMMARY OF DISCLOSURE**

In accordance with the above objects, a method is provided herein for intercepting and yawing a sailing vessel comprising the steps of despatching at least a first watercraft to approach the sailing vessel, securing the first watercraft to one side of said sailing vessel's hull, operating said first watercraft to direct propulsion to yaw said vessel in a desired direction. Preferably, at least a second watercraft may be further despatched to approach said sailing vessel. The first watercraft may be secured to one side of said sailing vessel's hull while the second watercraft may be secured to the other side of said vessel's hull. At least one of the watercrafts may then be operated to direct propulsion to yaw said vessel in a desired direction.

In one embodiment of the invention, the first watercraft is secured proximate to sailing vessel's stern and operated to direct propulsion away from said vessel's hull to yaw said sailing vessel to a direction on same side of the hull to which said first watercraft is secured. Preferably, a second watercraft is secured proximate to sailing vessel's stern but is not operated to direct propulsion with respect to said vessel's direction of sailing vessel. When the direction needs to be changed midway of yawing, the first watercraft's direct propulsion may be halted and the second watercraft second watercraft is operated to direct propulsion away from said vessel's hull so that the sailing vessel is yawed to a direction on the same side of the hull to which the second watercraft is secured.

In a second alternative embodiment, where the direction of yawing is predetermined, the first watercraft may be secured on one side of the sailing vessel's hull proximate to the stern and operated to direct propulsion away from said vessel's hull while the second watercraft is secured on the other side of the sailing vessel's hull proximate to the bow and operated to direct propulsion away from the vessel's hull.

In a third alternative embodiment, where the direction of yawing is predetermined, the first watercraft may be secured on one side of the sailing vessel's hull proximate to the stern and operated to direct propulsion in away from to push against said vessel's hull. The second watercraft may be secured on the same side of the sailing vessel's hull proximate to the bow and operated to direct propulsion to pull said vessel's hull towards said second watercraft.

Preferably, the watercrafts employed in any of these methods are equipped with fluid propulsion with thrust directional control including any one or combination of water jet propulsion with exhaust thrust directional control, gaseous jet propulsion with exhaust thrust directional control, including rocket propulsion means; and/or propeller systems with steerable propeller control.

In one aspect of the invention, the watercrafts is secured to the side of sailing vessel's hull by temporary non-destructive releasable attachment

means including any one or combination of electromagnetic means, vacuum suction means, or mechanical clamping or hook means. Fast acting securing means to secure said watercraft to the hull in a permanent or secure manner may also be employed, including employing any one or combination of explosive-propelled hull-piercing mechanical clamping means, hull-drilling with mechanical clamping means.

In one alternative embodiment, the watercraft may undertake operations involving personnel, including rescuing, evacuating, storming and the like wherein said watercraft is capable of freeing itself from said sailing vessel upon completing the undertaking.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

## LIST OF ACCOMPANYING DRAWINGS

The present invention will now be described in detail with reference to the accompanying drawings that follows, wherein specific embodiments are described as non-limiting examples or illustrations of the workings of the invention, in which:

FIGURE 1 shows a plan view of one aspect of our method in an early stage wherein a first watercraft approaches an errant vessel;

FIGURE 2 shows a plan view of another aspect of our method in which two watercrafts are used to yaw an errant sailing vessel; and

FIGURE 3 shows in plan view of the embodiment according to Fig. 2 in which the vessel is being yawed from its original direction of sail.

## DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The general embodiment of our method for intercepting and yawing a sailing vessel comprises despatching at least a first watercraft to approach the sailing vessel, securing the first watercraft to one side of said sailing vessel's hull, and operating the first watercraft to direct propulsion to yaw said vessel in a desired direction. Our preferred embodiment, however, as shown in

FIGURE 1, comprises despatching at least a pair of watercrafts after the errant vessel. Accordingly, in relation to the general embodiment, at least a second watercraft (14) is further despatched to approach the sailing vessel (10). The first watercraft (12) is secured to one side of said sailing vessel's hull while at least a second watercraft (14) is secured to the other side of the vessel's hull. At least one of the watercrafts (12, 14) is then operated to direct propulsion to yaw said vessel in a desired direction. Depending on the propulsion means equipped on the operative watercraft, it may preferably be secured on the side of the hull in which the direction of the vessel is to be yawed.

Hence, in the example of FIG. 1, the first watercraft (12) may be secured to the right side of the hull if the vessel's direction is to be changed to the right or to be turned clockwise. Preferably, the first watercraft is secured proximate to sailing vessel's stern and operated to direct propulsion away from said vessel's hull. In this arrangement, the sailing vessel (10) may be yawed to a direction on same side of the hull to which the first watercraft is secured.

In one embodiment, the second watercraft (14) may approach the vessel, also from the rear, on the other side of the vessel's hull and secure itself thereto. As the watercrafts are equipped with directional propulsion means, as described in the following, they can also approach the vessel from the front.

To commence the yawing task, one or more of the watercrafts (12, 14) which have been attached to the hull of the errant vessel operates its propulsion in an appropriate direction to yaw the vessel in the desired direction.

Depending on the propulsion means equipped on each of the watercrafts, the appropriate direction of yawing may be controlled by the watercraft crew. Conventional propulsion means may be employed such as water jet propulsion system with exhaust thrust directional control, or propeller systems with steerable propeller control. The basic requirement of the propulsion means is having thrust directional control. The watercraft may also be unmanned and remotely controlled from a safe distance rather than having a crew on board as the operation can be dangerous.

An example of a water jet propulsion system is the WARTSILA LJ150E or LJ200E series water jet propulsion unit. Two such units may be installed on a watercraft for use in the presently proposed method.

An example of a steerable propeller system is the SCHOTTEL rudder propeller unit having a rating of 6000 kW. Two units of this propeller system may be installed on a watercraft for this proposed method.

It is estimated that with a vessel length of 276 m and 40 m wide with a design draft of 12 m, the vessel's displacement tonnage may be estimated to be in the region of 73,000 metric tonnes. A vessel this mass and size travelling at 15 knots may be yawed by a watercraft equipped with a pair of any one of the above propulsion systems so that the vessel may be turned within a radius of 2 km.

In another embodiment, in collective reference to FIGURE 2 and FIGURE 3, a second watercraft may be secured proximate to the sailing vessel's (10) stern. This second watercraft (14) may or may not have its water propulsion means operable to yaw the vessel or to provide propulsion in a manner complementary to the efforts of the first watercraft (12). In other words, the second watercraft (14) may be secured to the vessel's hull and be placed on 'standby'.

Each of the watercraft may be provided with separate propulsion for its own normal navigation while having directional propulsion means to be used solely for the yawing of the errant vessel. In the alternative, however, a single propulsion system may be installed on the watercraft for both navigation purpose and yawing of the vessel.

When circumstances dictate that a change in the direction of yawing is necessary, the second watercraft (14) may be operable to provide the requisite propulsion while the first watercraft (12)'s propulsion operation is

halted. With reference to FIG. 2, to change the vessel, which was first shown being yawed to turn clockwise, to turn anticlockwise or to turn to the left of the original course of sail, the second watercraft (14) may now be operated to provide propulsion which direction of thrust is away from the vessel's hull while the first watercraft's propulsion is halted.

Accordingly, with two watercrafts secured on either side of the vessel to be yawed, the vessel may be propelled and steered by external force despite not having control of the vessel's own propulsion or steering. With the external propulsion being provided alternatingly by the two watercrafts, the vessel may even be manoeuvred between obstacles such as other moored ships, sandbars, buoys, etc.

In another aspect of our invention, where the direction of the vessel to be yawed to is predetermined and is unlikely to change or to be adjusted midway, the first watercraft (12) may be secured on one side of the sailing vessel's hull proximate to the stern and the second watercraft (14) may be secured on the other side of the sailing vessel's hull proximate to the bow. In this arrangement of diagonally opposing sides of the hull, the first watercraft (12) may be operable to direct propulsion away from said vessel's hull while the second watercraft (14) may be operable to direct propulsion away from said vessel's hull. Such arrangement, whereby the stern is yaw in one direction and the bow in the other, will enable the vessel's direction of sail to be changed in a much shorter distance. The direction of the vessel to be

altered or yawed may be predetermined since it is envisaged that a large turning radius is required due to the momentum of the vessel.

Each of the watercrafts may be secured to the side of the sailing vessel's (10) hull by a suitable temporary non-destructive, releasable attaching means including any one or in combination of electromagnetic means (such as a solenoid bank), vacuum suction means; and mechanical clamping or hook means. A number of such attaching means are disclosed in our co-pending International Patent Application No. PCT/SG2005/000178 filed on 3 June 2005 which disclosure is incorporated herein by reference.

The first watercraft's temporary attaching means may be used advantageously to quickly secure the watercraft (12, 14) to the vessel's hull while a more secure or permanent attaching means is being put in place. Such secure attaching means may include explosive-propelled hull-piercing mechanical clamping means (e.g. explosive-activated mechanical bolt) and hull-drilling with mechanical clamping means.

In addition to yawing, one or more of the watercraft may undertake operations such as rescuing, evacuating, storming and the like whereupon it is capable of freeing itself from said sailing vessel upon completing the undertaking.

It will be appreciated that a number of the above-described features of our invention may be adopted modularly, modified, reconfigured, or alternatively adapted which are still based on the same general concept, features and working principles of the present invention. For example, the method may be adapted for use at the bow of the errant vessel instead of at the stern. In fact, the position of attachment need not be at the bow or stern as it can be attach at any part of the vessel's body except that such position may not be as effective in yawing as it will require bigger propulsion power for the same manoeuvre, or a longer effective turning radius for the vessel.

Another possible variation is to have both the first and second watercrafts on the same side of the vessel's hull in which direction it is to be yawed. For example, the first watercraft may attach itself to the stern end of the errant vessel's right side while the second watercraft may attach itself to the bow end on the same, i.e. right side. To yaw the vessel to turn clockwise, the first watercraft may operate its propulsion system to direct the thrust away from the hull so that the stern portion of the vessel is pushed leftwards, thereby causing the vessel to turn rightwards while the second watercraft remains on standby. To change the direction of turning, the first watercraft may stop operating its directional propulsion and allow the second watercraft to direct its propulsion thrust away from the bow end of the hull so that the bow end is pushed leftwards, thereby causing the vessel to turn leftwards.

While this invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification(s). This application is intended to cover any variations uses or adaptations of the invention following in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth.

As the present invention may be embodied in several forms without departing from the spirit of the essential characteristics of the invention, it should be understood that the above described embodiments are not to limit the present invention unless otherwise specified, but rather should be construed broadly within the spirit and scope of the invention as defined in the appended claims. Various modifications and equivalent arrangements are intended to be included within the spirit and scope of the invention and appended claims. Therefore, the specific embodiments are to be understood to be illustrative of the many ways in which the principles of the present invention may be practiced. In the following claims, means-plus-function clauses are intended to cover structures as performing the defined function and not only structural equivalents, but also equivalent structures. For example, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface to secure wooden parts together, in the

environment of fastening wooden parts, a nail and a screw are equivalent structures.

"Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof."

**CLAIMS**

We claim:

1. A method for intercepting and yawing a sailing vessel (10) comprising the steps of:

(a) despatching at least a first watercraft (12) to approach said sailing vessel (10);

(b) securing said first watercraft (12) to one side of said sailing vessel's hull;

(c) operating said first watercraft (12) to direct propulsion to yaw said vessel in a desired direction.

2. A method according to Claim 1 wherein

(a) at least a second watercraft (14) is further despatched to approach said sailing vessel (10);

(b) securing the first watercraft (12) to one side of said sailing vessel's hull;

(c) securing at least second watercraft (14) to the other side of said vessel's hull;

(d) operating at least one of said watercrafts (12, 14) to direct propulsion to yaw said vessel in a desired direction.

3. A method according to Claim 1 wherein the first watercraft is secured proximate to sailing vessel's stern and operated to direct propulsion away

from said vessel’s hull to push and yaw said sailing vessel (10) to a direction on same side of the hull to which said first watercraft is secured.

4. A method according to Claim 2 wherein the first watercraft is secured proximate to sailing vessel’s stern and operated to direct propulsion away from said vessel’s hull to push and yaw said sailing vessel (10) to a direction on same side of the hull to which said first watercraft is secured.

5. A method according to Claim 4 wherein a second watercraft is secured proximate to sailing vessel’s (10) stern and is not operated to direct propulsion with respect to said vessel’s direction of sailing vessel.

6. A method according to Claim 4 wherein the yawing direction is changed midway of yawing when the first watercraft’s direct propulsion is halted and the second watercraft is operated to direct propulsion away from said vessel’s hull to push and yaw said sailing vessel (10) to a direction on the same side of the hull to which said second watercraft (14) is secured.

7. A method according to Claim 2 wherein the direction of yawing is predetermined and wherein

- first watercraft (12) is secured on one side of the sailing vessel’s hull proximate to the stern and operated to direct propulsion away from said vessel’s hull, and

- second watercraft (14) is secured on the other side of the sailing vessel’s hull proximate to the bow and operated to direct propulsion away from said vessel’s hull.

8. A method according to Claim 2 wherein the direction of yawing is predetermined and wherein

- first watercraft (12) is secured on one side of the sailing vessel’s hull proximate to the stern and operated to direct propulsion in away from said vessel’s hull and push against said hull, and
- second watercraft (14) is secured on the same side of the sailing vessel’s hull proximate to the bow and operated to direct propulsion to pull said vessel’s hull towards said second watercraft (14).

9. A method according to any of the foregoing claims wherein at least one of the watercraft is equipped with fluid propulsion with thrust directional control including any one or combination of:

- water jet propulsion with exhaust thrust directional control;
- gaseous jet propulsion with exhaust thrust directional control, including rocket propulsion means; and
- propeller systems with steerable propeller control.

10. A method according to any of the foregoing claims wherein at least one of the watercrafts is secured to the side of sailing vessel’s hull by temporary

non-destructive releasable attachment means including any one or combination of:

- electromagnetic means;
- vacuum suction means;
- mechanical clamping or hook means.

11. A method according to any of the foregoing claims wherein at least one of the watercraft employs fast acting securing means to secure said watercraft to the hull in a permanent or secure manner, including employing any one or combination of:

- explosive-propelled hull-piercing mechanical clamping means;
- hull-drilling with mechanical clamping means.

12. A method according to any one of Claims 10 and 11 wherein said watercraft is capable of freeing itself from said sailing vessel upon completing its undertaking.