

- [54] STEERABLE AQUA-SLED
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96813
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- [51] Int. Cl. .... **A63c 5/00**
- [58] Field of Search ..... **114/235 WS, 16 A, 235 A;**  
**115/6.1; 9/310 R, 310 A, 310 B, 310 C, 310**  
**E; 244/153 R**

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[57] **ABSTRACT**

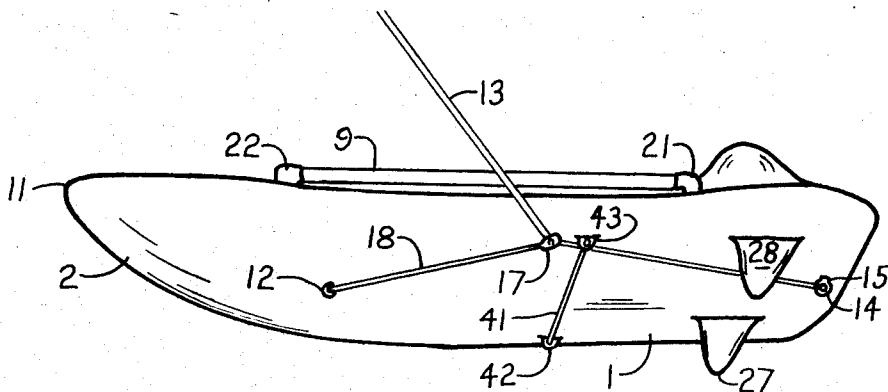
A water sled which when towed behind a moving boat is steerable from side to side by a rider in a simple but effective manner. This positive maneuverability is accomplished by moving the effective point of attachment of the towline to the sled from a point on the bow to a point on the side of the sled causing the sled to become aligned at some appreciable angle to the towline direction. The relative water flow striking the sled at an angle and the two bottom skegs cause the sled to dart to the outside of the towboat wake. The rider changes the effective towline attachment point and executes these maneuvers by pulling on or releasing a single control rope which attaches to the towline. The towline, in turn, is fastened to the stern of the sled.

**14 Claims, 11 Drawing Figures**

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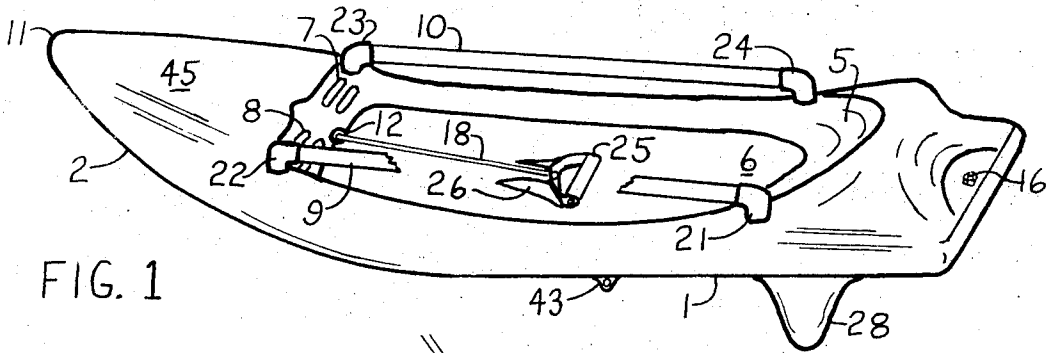


FIG. 1

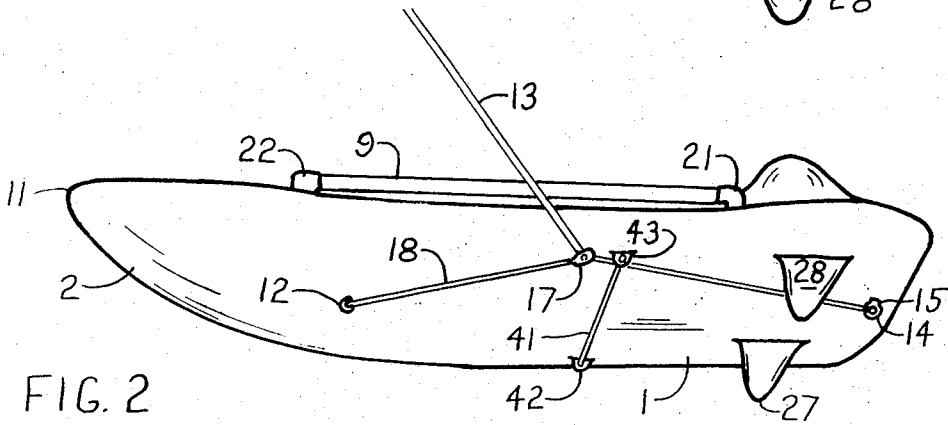


FIG. 2

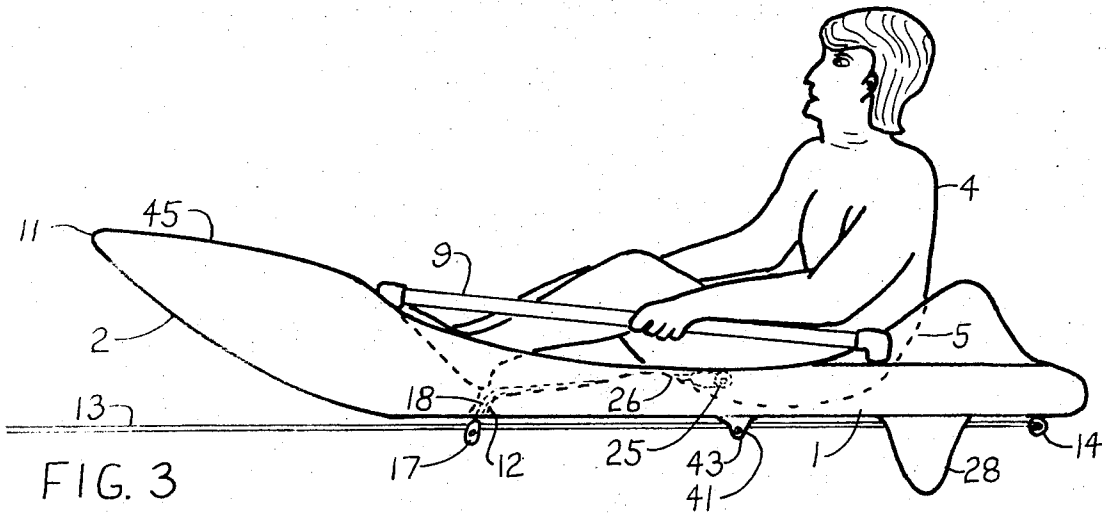


FIG. 3

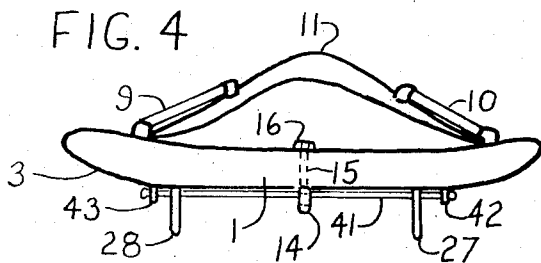


FIG. 4

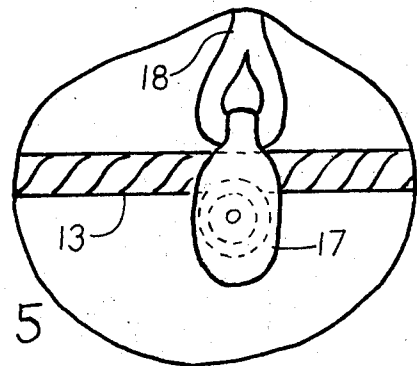


FIG. 5

FIG. 6

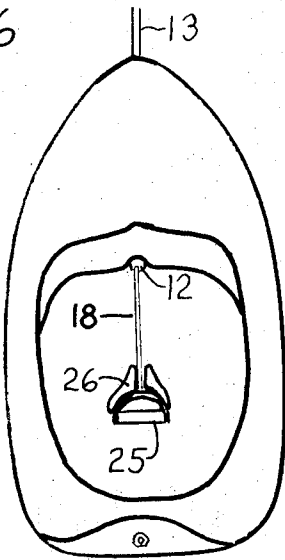


FIG. 9

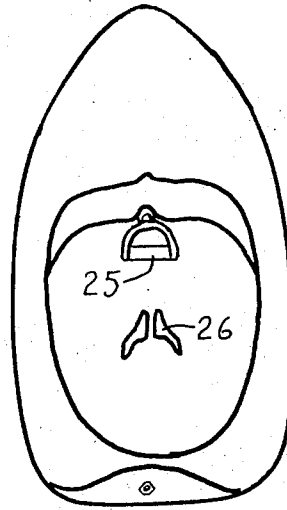


FIG. 7

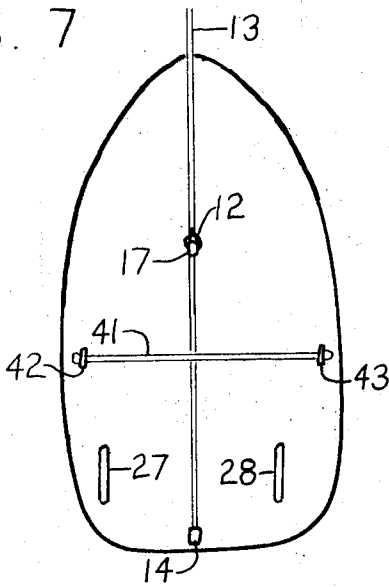


FIG. 10

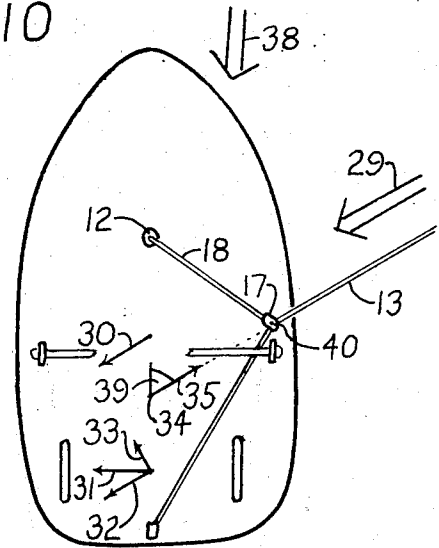


FIG. 8

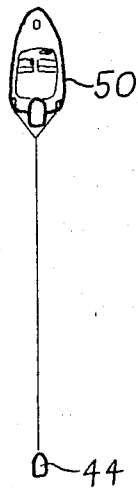
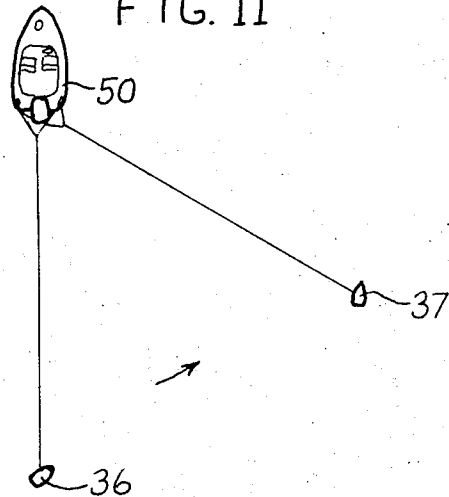


FIG. 11



## STEERABLE AQUA-SLED

## BACKGROUND OF THE INVENTION

The aqua-sled is intended mainly for use in the field of water sports and recreation but might also find application in the areas of oceanographic survey, diver mobility, and the like. With the expanding trend toward more leisure time and the increasing popularity of waterborne recreation, new and exciting water spots and games are desirable.

The aqua-sled is used in a fashion similar to water skis and aquaplanes, i.e., while being towed behind a speedboat. It has the maneuverability of water skis with the advantage of freeing the rider from the strain of holding the tow rope and the other physical demands required to maneuver on skis. The aquaplane, which has the towline attached, makes minimal physical demands upon the rider yet is virtually unsteerable. Modifications to the aquaplane design have yet to produce effective steering control. Still other designs appear to allow relative position control with respect to the towboat yet do not cause the bow of the sled to point in the direction of relative movement.

This invention combines the advantages of positive steering control with minimum physical demands upon the rider. The preferred rider position is seated, although other positions such as standing, prone, or kneeling are easily conceived.

## BRIEF SUMMARY OF THE INVENTION

The aqua-sled is a small watercraft which has a boat hull type underbody and is shaped on the topside to carry a seated person. A form fitting seat and backrest as well as foot rests provide a degree of comfort and a secure placement for the rider. Handgrips or rails run along each side to provide a means for holding on. The weight and physical dimensions of the sled are such that it can probably be lifted and carried by one person.

The aqua-sled is towed behind another vessel, such as a speedboat, by a towline attached from the towboat to the sled.

The invention provides a simple means whereby the rider or operator, with minimal effort, can steer the sled from side to side as it skims along the water surface.

The steering principle lies in controlling the effective point of attachment of the towline to the sled. The sled will tow directly behind the towboat, bow directed in the towing direction, when the towline effectively is attached to the forward part of the sled on the centerline. Moving this effective attachment point around to one side, say to the left, causes the sled to assume a towing attitude in which its centerline is at an oblique angle with the towline. For example, the bow of the sled would then be pointed at some angle to the right of the towing direction. This change of alignment takes place to satisfy the equilibrium requirement for a balance of moments on the sled due to hydrodynamic and towline forces.

It is important that the attachment point be moved sufficiently far around to one side such that the resulting angle assumed by the sled with respect to the towline is appreciable, such as 45 to 80 degrees. This will provide positive steering control with ability to maneuver far to the outside of the towboat wake.

Skegs or fins which are attached to the underbody, near the stern and parallel to the centerline, assume an angle of attack with the relative water flow past the underbody once the sled attitude has been changed. Horizontal hydrodynamic lift forces develop on these skegs as well as on edges of the hull. These forces, temporarily unbalanced, cause the sled to move out rapidly to the right side of the towboat, similar to the action of a water skier.

The sled reaches a new equilibrium position, where all components of lift, drag, and towline forces balance, and relative motion between the sled and the towboat ceases. The sled will remain in this relative location with respect to the towboat until the operator returns the effective point of attachment of the towline to its original position on the bow. This will result in the sled resuming station directly astern of the towboat, bow pointing in the towing direction.

The operator can similarly cause the sled to move to the left by shifting the towline attachment point to the right side of the sled.

To achieve the greatest thrill, it is possible to steer the sled from the extreme position on one side of the towboat to the corresponding position on the other side. This is accomplished by changing the towline attachment point from one side of the sled directly to the other side. The sled will cross the boat wake at a speed higher than that of the towboat providing thrills and excitement to the rider.

The steering is best accomplished, as shown in greater detail later, by a scheme in which the operator adjusts the length of a single control rope. The control rope, about 13 inches long, passes through an opening in the body of the sled, on the centerline, forward. The end of the rope on the topside of the sled attaches to a handle. The end of the control rope which passes out the bottom side is attached to the body of a small pulley. The towline passes through the pulley and is firmly attached to a padeye on the centerline at the stern.

When the operator pulls the handle and thus pulls the control rope taut, the towline is snubbed up tightly against the underside of the sled at the location of the opening. In this mode the towline is effectively attached at this point in that it is prevented from moving horizontally or vertically there. The sled then will tow in a path directly behind the towboat.

When the handle is released, allowing the control rope to pay out, drag forces on the forward part of the sled cause the bow to rotate to one side or the other about the point of towline securement at the stern until the control rope again becomes taut. The direction of turning is controlled by leaning or otherwise shifting weight at the time of letting out the control rope. The sled is now being towed from two points — one at the stern and one near the bow — in a bridle-like configuration. The effective point of towline attachment in the horizontal plane is at the junction of the two legs of the bridle, which is now to one side of the centerline. The sled thus achieves an oblique orientation to the direction of towing, and a resulting lateral velocity component is developed as described earlier. By pulling on the control rope and snubbing in the towline tightly back to the opening, the sled will resume its initial towing behavior.

Skipping across a wake from one side of a towboat to another is accomplished by pulling in on the tow rope and then releasing it as the sled's bow points toward the

boat. That procedure quickly changes the effective point of towline connection from one side of the sled to the other.

This scheme is used for its simplicity, ease of control, minimum of moving parts, and its compatibility with desired low cost of manufacture of the sled. Additionally, the bridle-like arrangement which results upon release of the control handle provides for greater directional stability in yaw than would be provided by a single point of attachment.

Other means of accomplishing this steering principle can be conceived. Schemes such as using a steering wheel to rotate the attachment point around the bow or to wind the control rope on a drum, a track or rail running around the bow, having a slide thereon to which the towline would attach, and the like, would be useful in apparatus of the present invention.

Likewise the sled may be made larger to accommodate more than one person; the operator may ride in varied positions such as sitting, kneeling, standing, or prone; the function of the skegs may be replaced by a similar shaping of the underbody; the sled may be designed to operate beneath the water surface as for divers or the steering principle may even find application on land, such as in the snow.

One of the principle objects of the invention is to provide a steerable, towed vehicle upon which a person can ride for fun and sport, and which is easily operable by the young and inexperienced.

Another object is to produce a towed water vehicle which can be steered simply and with minimum effort, resulting in abrupt, positive turns in which the bow always points in the direction of relative movement (thus creating the feeling of independence from the towboat), with directional stability during maneuvers (once on a heading), without need for pronounced body weight shifts to effect turns or to avoid edges digging in, and allowing steering control while the sled remains in a comfortable, horizontal attitude.

Another object is to provide a towed vehicle whose steering mechanism is simple and inexpensive to manufacture.

Another object is to provide a steering mechanism for towed vehicles that can be applied in areas other than water recreation, such as oceanography, scuba diving, etc.

Still other objects are apparent from the disclosure in the drawings and specification, which includes the claims.

#### BRIEF DESCRIPTION OF THE VIEWS OF THE DRAWING

FIG. 1 is a top perspective view of the aqua-sled showing the control rope and handle in the rear position for towing in the path of the towboat.

FIG. 2 is a bottom perspective view of the sled showing the towline and control rope arrangement for towing to the right side of the towboat, and showing the athwartship snubber line which holds the tow rope close to the bottom of the sled.

FIG. 3 is a side view in elevation showing the rider seated in the preferred riding position.

FIG. 4 is a rear view in elevation of that shown in FIG. 1.

FIG. 5 is a detail view of the pulley which joins the control rope to the towline.

FIG. 6 is a top plan view of the aqua-sled with the control handle in the rear position for towing in the path of the tow vessel.

FIG. 7 is a bottom plan view of that shown in FIG. 6.

FIG. 8 is a top plan view of the approximate relative position of the sled with respect to the towboat while in the towing mode as depicted in FIGS. 6 and 7.

FIG. 9 is a top plan view of the sled with the control handle in the forward position for towing to one side of the towboat.

FIG. 10 is a bottom plan view of that shown in FIG. 9 showing some of the forces involved.

FIG. 11 is a top plan view of the approximate relative positions and attitudes of the sled with respect to the towboat both at the moment of initiation of lateral movement and later when equilibrium is established.

#### DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1, 2 and 3, the particular form of the invention, as illustrated, shows the water vehicle or water sled 1 having a boat type hull with a planing-type underbody which has a relatively flat bottom near the stern to provide vertical lift. Forward portion 2 and sides 3 are curves upward and outward. These curved or sloped sections allow the sled to skim the water surface without digging in or burying itself in small waves such as the boat wake. Skegs or fins 27 and 28 are attached to the underbody near the stern to aid in turning.

The sled may be made of two halves or shells formed of fiberglass or plastic joined along a seam. The interior could be hollow or filled with a plastic foam, or the sled could be made solely from a tough plastic foam or even wood. The skegs may be made of fiberglass, wood or metal and attached to the hull or be formed as an integral part of the bottom shell.

The midbody of the top of the sled is hollowed out or scooped out in a shape to permit a person 4 to ride upright in a seated position. A curved section near the stern provides a backrest 5 and seat 6. Padding can be provided on the seat and backrest for comfort.

The person's legs, slightly bent at the knees, extend forward, and his feet rest on sloped sections of the hull or footpads 7 and 8. Nonskid paint or strips are applied there. This enables the rider to brace his body firmly between the footrests and backrest to assist in keeping his position on the sled. Also, on the top and running along each side of the sled are two handrails 9 and 10. These may be made of wooden rods and may be attached to the sled body by insertion in sockets 21, 22, 23 and 24, which are fixed to the sled. An alternate means of construction would be to have the handrails as an integral part of the formed shell.

Forward of the footrests, the top of the hull 45 is flat and is raised above the part of the sled which the rider occupies. It meets the upward sloped forward portion of the bottom to form a high bow 11.

The unique steering arrangement is accomplished with a towline 13 which is firmly attached to a ring 14 at the stern and on the bottom of the sled on its centerline. This must be located aft of the center of effort of all applied hydrodynamic forces on the sled. The ring is welded to a bolt 15 which passes through an opening in the body and is held by a nut 16, as best shown in FIG. 4. The towline runs through a pulley 17, the body of which is attached to the control rope 18. The control

rope in turn runs through an opening 12 in the forward central portion of the bottom hull and emerges on the top side of the sled where its end is securely attached to a handle 25. The handle, made from wood or plastic, is shaped so that it can be firmly gripped by either of the rider's hands. When the handle 25 is pulled inward or to the rear of the sled, the control rope 18 draws the pulley 17 up snugly against the opening 12 and likewise holds the tow rope fixed at this point, thus in effect causing the tow rope to be attached at this point on the hull. FIGS. 3 and 7 show this bottom configuration. With the control handle in the rear position, the sled will tow directly in the path of the towboat, bow pointing in the towline direction. FIG. 8 shows the sled's location 44 relative to that of the towboat 50. A variation of this scheme would eliminate the pulley and have the control rope tied or otherwise fixed directly to the towline at the location on the towline occupied by the pulley when in this towing configuration. The pulley, however, permits a smoother operation and allows the control rope to be shorter than it would have to be without the pulley.

A raised section 26 of the hull top provides a seat shaped to receive and hold the control rope handle firmly when it is in the rearward position as shown in FIG. 1 and FIG. 6. This relieves the rider of holding the control rope. Several handle-anchoring positions may be provided. A modified form of the invention would replace section 26 with an alternate means of holding the control rope in position such as a jam cleat affixed near opening 12. The jaws of the cleat would grip the control rope and hold it at any position desired.

When the control handle 25 is released from its seat 26, the control line is allowed to run out freely through opening 12. Drag forces on the hull, being centered at a point forward of the towline attachment point 14, cause the sled to rotate about point 14 as the control rope pays out. A slight body weight shift will dictate in which direction, right or left, the bow will rotate. When the control handle reaches the top entry of opening 12, it is prevented from passing through the opening due to its size, as shown in FIG. 9, and the control rope is held from running out further.

Towing strain is now taken by a bridle like configuration with one leg attached near the bow at opening 12 and one at the stern at ring 14.

While an understanding of forces operating on the sled to cause its unique operation are not necessary, the following is believed to be a reasonable explanation of the forces which operate on the sled. At the outset, relative water flow impinges upon the underbody at an angle as shown by the vector 29 in FIG. 10. Hydrodynamic forces act upon the hull and skegs. The total drag force on the sled is approximated by arrow 30. The combined lift, or pressure, force on both skegs is depicted by vector 31 which is shown acting at a point midway between the skegs. The components of lift parallel to the water flow and that perpendicular to it are shown by vectors 32 and 33 respectively.

The force on the sled counteracting these hydrodynamic forces is the pull of the towline, shown by vector 35. As can readily be seen, vector 35 is capable of balancing drag vector 30 and lift component 32 but is unable to counteract lift component 33. This unbalanced force causes the sled to move abruptly in a direction away from the towing direction, in this case to the right as shown in FIG. 11. Position 36 in FIG. 11 shows the

sled position and alignment relative to the towboat 50 immediately after the release of the control handle. As the sled approaches position 37, equilibrium is brought about when the direction of water flow impinging upon the skegs reduces to a small angle as shown by vector 38 in FIG. 10 causing the magnitude of lift component 33 to approach zero.

An important teaching of this invention is that the angle 39 that the towline makes with the sled centerline governs the position to the side of the towboat that the sled will attain — the greater the angle, the farther up alongside towboat 50 sled 1 can maneuver. A successful steering mechanism must provide the capability to maneuver at least to the outside of the boat wake and preferably to approach coming abeam of the towboat.

It can easily be shown that the hydrodynamic force vectors 31 and 32 can be combined and replaced by a single vector acting through a point, 34 in FIG. 10, somewhere between them. A free body diagram will show that for the condition of rotational equilibrium that exists when the control rope becomes taut, the towline force vector 35, or in other words the extension of towline pull, must also act through that identical point. This point for a sled with a planing hull will be in the stern section. Thus, in order for towing angle 39 to be sufficiently large, say 45° or more, the vertex of the towing bridle 40 in FIG. 10, or what has previously herein been called the effective point of towline attachment, must be located a good distance around to one side of the sled. With the towline-control rope system described, this point can easily be adjusted to a design optimum by simply selecting the correct control rope length for the particular sled hull design and skeg placement.

It is also apparent that the flexible bridle, formed by the control rope and the section of towline, provides more directional or rotational stability to the sled in the face of occasional outside disturbing forces than would be provided if the bridle were replaced by a single fixed attachment point at the bridle vertex.

As best seen in FIGS. 2, 4, 7 and 10, a snubber or preventer rope 41 stretches tightly across the bottom of the sled between hull protrusions 42 and 43, and passes over the towline 13. Sufficient clearance is allowed between this rope 41 and the sled bottom to allow the towline to pass freely between them during maneuvering. The purpose of the preventer rope 41 is to hold the towline against the hull, preventing the sled from tipping or rolling to the outside on a turn — a function which is also partially performed by the inward roll moment developed on the skegs by the water force.

The preferred mode of operation is to have the sled towed to planing speed with the rider aboard and the control handle 25 held by the seat 26. The rider then lifts up the handle, releasing it from the seat and letting it go. At the same time he shifts his weight slightly to the right or left, depending upon the direction of travel desired. After a momentary pause, the sled will rotate smartly toward the side chosen and dart quickly to that side of the towboat, arriving at a station outside of the boat wake.

The rider can cause the sled to move relatively further forward by leaning to the outside, depressing edges of the hull, thus creating more lift and possibly moving point 34 further forward and increasing angle 39.

The sled will remain to this side of the towboat until the rider pulls on the control handle 25 and returns it to its seat 26, which would cause the sled to resume position 44. Instead, and to provide the greatest thrill, he may pull the control handle 25 to its rearward position, hold it momentarily, and release it again. This would cause the towline to become positioned on the opposite side of the sled, sending the sled darting across the boat wake and taking station on the opposite side of the towboat. An extreme shift of weight can accomplish this cutback without pulling and releasing the control rope; however, this requires a higher degree of skill and is more dangerous.

The towline must be attached to the towboat at about four feet above the water to avoid having the line drag in the water and hinder control.

The planing hull shape described herein is designed for towing at high speeds behind fast boats. A displacement-type hull could be used for towing behind slower boats, such as sailboats, using the same steering principle.

Although the invention has been described in part by reference to a preferred embodiment, it is obvious that modifications may be made. The precise scope of the invention is defined in the following claims.

I claim:

1. A towed water sled vehicle comprising a body, a first rope attachment mounted on the body near a stern thereof, a second rope attachment mounted on the body forward of the first attachment, a first rope connected to the first attachment and a second rope connected to the second attachment, joint means for joining the ropes remote from the attachments, means on the body for pulling the joint means toward a center of the body and means on the body for shifting the joint means from one side of the body to another, and means for towing the vehicle from the joint means.

2. The towed water sled vehicle of claim 1 wherein the first rope and the means for towing the vehicle comprise a single tow rope connected to the first attachment and passing through the joint means.

3. The towed water sled vehicle of claim 1 wherein the second attachment comprises adjustable means for holding the second rope at varied positions whereby the joint means is held by the second rope at varied proximity to the body.

4. The method of towing a water sled craft comprising towing the water sled craft by pulling at an angle to a centerline of the water sled craft on a joint means rearward of a bow along a first side of the water sled craft rearward of a bow, moving the joint means toward the centerline of the craft, and moving the joint means to a second side of the craft and sequentially moving the joint means toward the centerline and from one side of the craft to another side of the craft.

5. The method of towing a craft of claim 4 wherein the pulling comprises connecting a towline to a stern of a towed craft, pulling generally forward on the towline, pulling inward on the towline toward a centerline of the craft from a point on the craft forward of the stern, and controlling a distance of the towline from the point.

6. The method of claim 5 further comprising restraining a portion of a towline which is adjacent the craft for movement substantially parallel to a surface of the craft.

7. The method of claim 4 wherein the pulling step comprises pulling at a side of the craft between a bow

and a stern of the craft, whereby the sled attains an angle of about from 40° to 80° with respect to towline direction.

8. Towed water vehicle comprising a hull, means connected to the hull for holding a towline at a first side of the hull rearward of a bow of the vehicle, means to move the towline toward a center of the hull, and means connected to the hull for shifting the towline from one side of the hull to another side of the hull and back, whereby the towed water vehicle attains an angle of about from 30° to 80° with respect to a direction of a towline, on either side of the towed water vehicle.

9. A towed vehicle comprising a body, a first rope attachment mounted on the body near a stern thereof, a second rope attachment mounted on the body forward of the first attachment, a first rope connected to the first attachment and a second rope connected to the second attachment, joint means for joining the ropes remote from the attachments and means for towing the vehicle from the joint means wherein the second attachment comprises an opening in the vehicle body and wherein the second rope passes through the opening, and further comprising a handle on one end of the second rope and a cleat for holding the handle remote from the opening whereby the joint means is held adjacent the opening, and whereby releasing the handle from the cleat permits the handle to be moved toward the opening and the joint means to be moved away from the opening.

10. The towed vehicle of claim 9 wherein the body comprises a water sled having a planing hull configuration with a curved upward bow and sides and a generally flattened bottom near a stern, and having a dish passenger compartment with an integrally formed back rest and seat and foot rests on sloped forward walls of the compartment and handhold rails extending fore and aft along opposite sides of the compartment, and downward extended skegs mounted on the hull bottom near the stern, and wherein the second attachment opening extends through the hull on a centerline of the craft from between spaced foot rests in the passenger compartment through the bottom of the hull and wherein the cleat is in the passenger compartment for holding the second rope.

11. A towed vehicle comprising a body, a first rope attachment mounted on the body near a stern thereof, a second rope attachment mounted on the body forward of the first attachment, a first rope connected to the first attachment and a second rope connected to the second attachment, joint means for joining the ropes remote from the attachments and means for towing the vehicle from the joint means, and a holding means connected across the vehicle for holding the first rope close to the vehicle between the vehicle and the holding means, thereby preventing tipping of the vehicle.

12. The method of towing a craft comprising connecting a towline directly to a stern which is always rearward of a bow of a towed craft, pulling generally forward on the towline at an angle to a centerline of the craft on a side of a craft, pulling inward on the towline toward a centerline of the craft from a point on the craft forward of the stern, and controlling a distance of the towline from the point, sequentially holding the towline close to the point, allowing the towline to be pulled a distance from the point on one side of the centerline, holding the towline a fixed distance from the

point on one side of the point, pulling the towline to the centerline of the craft, allowing the towline to be pulled to a second side of the centerline, and holding the towline at a fixed distance from the point on the second side of the centerline.

13. A towed vehicle comprising a body, a first rope attachment mounted on the body near a stern thereof, a second rope attachment comprising handle means mounted on the body forward of the first attachment, a first rope connected to the first attachment and a second rope connected to the second attachment, means for joining the ropes remote from the attachments and means for towing the vehicle from the joint means, wherein the joint means comprises a pulley having a fixed portion attached to the second rope remote from the second attachment and wherein the first rope and means for towing comprises a single tow rope threaded

through the pulley and having a terminus attached to the first attachment.

14. A towed vehicle comprising a body, a first rope attachment mounted on the body near a stern thereof, a second rope attachment mounted on the body forward of the first attachment, a first rope connected to the first attachment and a second rope connected to the second attachment, joint means for joining the ropes remote from the attachments and means for towing the vehicle from the joint means wherein the second attachment comprises an opening in the vehicle body and wherein the second rope passes through the opening, whereby the second rope moves in the opening to hold the joint means at varied proximity to the body.

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