Dec. 27, 1966 L. A. COTTRELL 3,294,345

TOWED SOARING CRAFT

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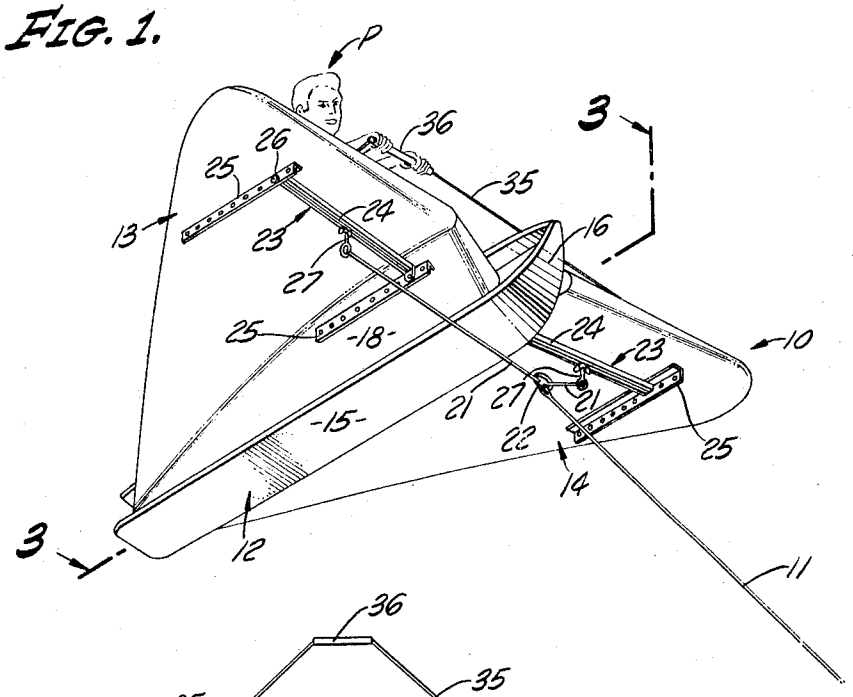
FIG. 1.



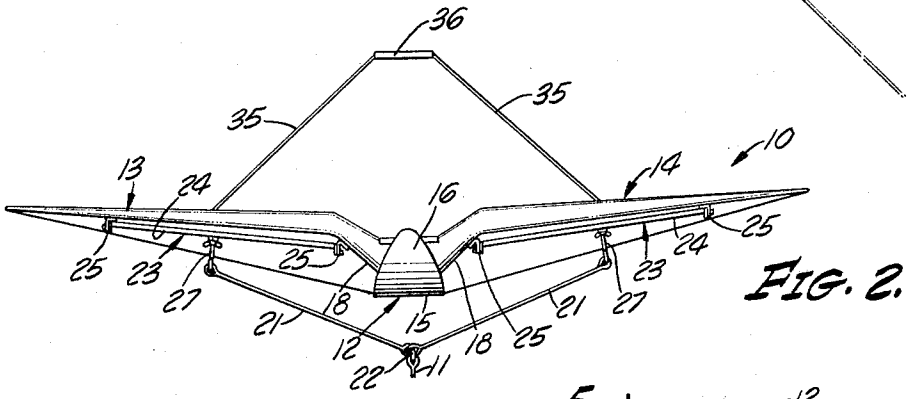


FIG. 2.

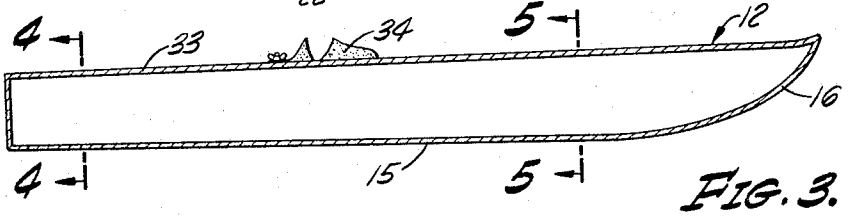
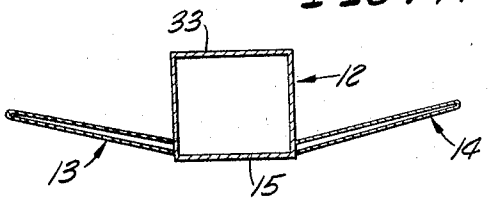


FIG. 3.

FIG. 4.



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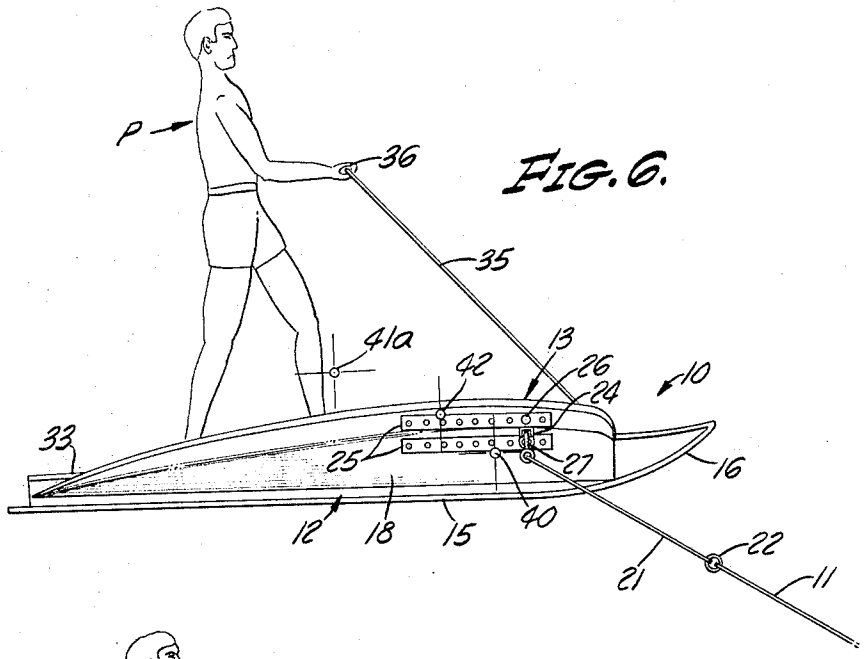

FIG. 6.

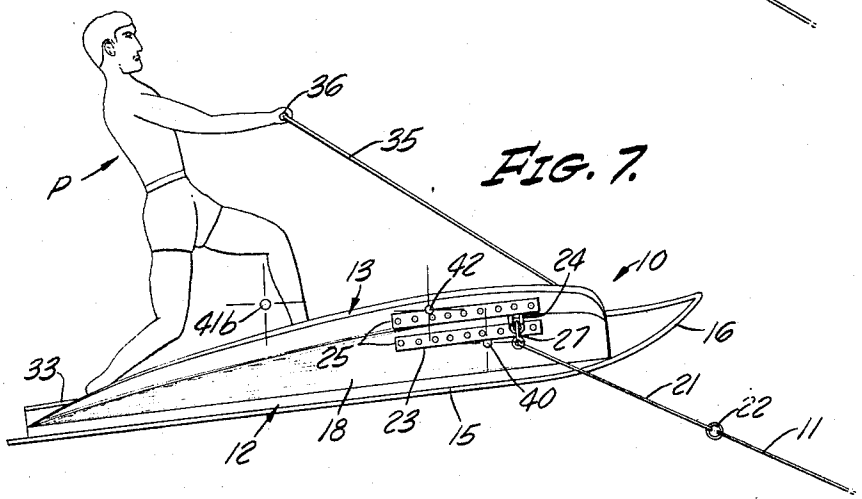

FIG. 7.

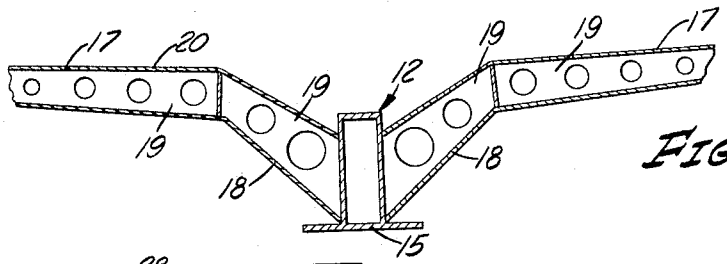

FIG. 5.

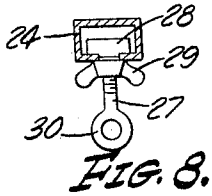

FIG. 8.

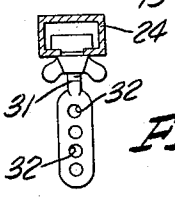

FIG. 9.

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3,294,345

TOWED SOARING CRAFT

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11 Claims. (Cl. 244—3)

This invention relates to a buoyant craft to be towed by a boat and ridden by a pilot and which becomes airborne above certain minimum speeds for controlled soaring by the pilot.

As an adjunct to water skiing, there has been developed a kite which is supported above and ridden by a water skier to lift the water skier airborne after proceeding along the water on conventional water skiis until reaching a minimum speed. The thrill and perhaps enjoyment of such a ride are apparent, but the strength required and difficulty of operating such a kite limits the use of such kites to a very few persons having the proper training and skill. The natural instability of the kite and the precarious position of the operator-skier often results in mishaps during flight and landing with resultant injury to the skier.

It is a principal object of this invention to provide a novel form of flying craft to be towed by a boat wherein the user rides on top of the craft and has much greater freedom for both control and safety.

Another object of this invention is to provide a novel soaring craft of a buoyant construction for being towed behind a boat until sufficient speed is reached for the airfoils of the craft to produce sufficient lifting force to make the craft airborne.

A further object of this invention is to provide a novel form of buoyant craft adapted to be towed by a boat and having a bottom surface of a type for planing along the water surface and with airfoils positioned above the water surface during such planing to lift the craft off of the water.

Still another object of this invention is to provide a soaring craft adapted to be pulled by a tow line attached forward of the center of lift of the craft's airfoils and with a platform for the pilot located behind such center of lift whereby flight is stabilized and control is achieved merely by the pilot shifting his weight.

A still further object of this invention is to provide a soaring craft having an adjustable tow line connection for selective variation of the longitudinal, lateral and vertical attachment location to accommodate variation in the size of different pilots and styles of operation.

Other and more detailed objects and advantages of this invention will appear from the following description and the accompanying drawings, wherein:

FIGURE 1 is a perspective view from below of the craft of this invention in flight.

FIGURE 2 is a front elevation of the craft of this invention.

FIGURE 3 is a longitudinal sectional view taken substantially on the line 3—3 shown in FIGURE 1.

FIGURE 4 is a sectional end view taken substantially on the line 4—4 shown in FIGURE 3.

FIGURE 5 is a fragmentary sectional end view taken substantially on the line 5—5 shown in FIGURE 3.

FIGURE 6 is an elevation view of the craft of this invention during flight with the occupant-pilot in a relatively neutral position for level flight.

FIGURE 7 is an elevation view similar to FIGURE 6 but with the occupant-pilot in a rearwardly shifted position to urge the craft to an inclined climbing attitude for achieving greater altitude.

FIGURE 8 is an enlarged sectional elevation of the tow line attachment fitting shown in FIGURES 1, 2, 6 and 7.

FIGURE 9 is a view similar to FIGURE 8 of a modified form of attachment fitting for allowing vertical adjustment of the tow line connection.

Referring now in detail to the drawings, the soaring craft, generally designated 10, of this invention is here illustrated for convenience as being adapted for operation and use by a single person or pilot P although it is to be understood that through obvious modifications in size and equipment, the craft could be adapted to accommodate more than one such person. The craft is adapted to be towed by tow line 11 from a power boat (not shown) or perhaps any other powered vehicle adapted to proceed along, over or immediately adjacent a body of water.

The soaring craft 10 may be an integrally constructed unit or body comprised generally of a central hull, generally designated 12, and a pair of airfoil wings, generally designated 13 and 14, extending outwardly from either side of the hull 12. The hull 12 is in the general form of an airtight pontoon for producing buoyancy of the entire structure, but the precise configuration of the hull 12 may vary substantially to accommodate particular preferences or appearances without departing from this invention. The bottom surface 15 of the hull 12 is of a shape and has an upturned front portion 16 for causing the hull to rise in the water upon increased speeds to eventually ride upon the surface of the water in a planing relationship similar to that achieved on water skiis.

The airfoil wings 13 and 14 may be of most any desired construction and configuration to produce the necessary aerodynamic lift needed for supporting both the craft and the pilot P airborne. The airfoil portions 17 of the wings 13 and 14 are positioned a substantial distance above the planing surface 15 of the hull whereby planing of the craft 10 along the water surface positions the airfoil portions 17 for passing through the air to produce the desired aerodynamic lift. In the particular embodiment shown in the drawings, the airfoil wings 13 and 14 are of a somewhat "gull wing" shape having upwardly and outwardly extending root portions 18 joining the hull 12 to the respective airfoil portions 17. The wings 13 and 14 are rigid or at least semi-rigid and are constructed in the conventional fashion with the necessary light-weight structural members 19 for achieving such rigidity. The "skin" 20 of the wings may be comprised of any material of adequate strength and ruggedness to withstand the wear and use and, in this regard, it is preferred to use sheet aluminum. While it is not essential to this invention, the tapered or bat-wing shape of the airfoil wings 13 and 14 as clearly illustrated in FIGURE 1, is preferred for aesthetic reasons and some structural and pilot comfort advantages.

Means are provided for adjustably connecting the tow line 11 to the craft 10 and, as shown in the drawings, these means may include a pair of yoke arms 21 linked to the tow line 11 at 22. The yoke arms are positioned for straddling the hull 12 and are connected to adjustable mounting brackets 23 on either side of the hull. Each mounting bracket 23 includes a slotted track 24 extending laterally between a pair of longitudinal rails 25 which have a plurality of spaced holes therealong. A fastener 26, such as a nut and bolt, releasably connects each end of track 24 to a rail 25 at selected holes for longitudinally locating the track 24 in the desired position. A stud 27 having an enlarged head 28 is slidably mounted in each track 24 and is provided with a wing nut 29 for locking the stud at any desired lateral location thereof. The stud 27 is provided an eye portion for forming a swivel link connection with a yoke arm 21. Thus the mounting brackets 23 permit wide variation in the location of connection between the towline and the craft, the purpose of which is discussed below.

In the modification of FIGURE 9 the stud **31** is similar to stud **27** but is provided with a plurality of vertically spaced holes **32** for selective connection of the yoke arm **21** rather than the single eye portion **30**. This permits vertical adjustment of the location of the connection between the craft and the tow line.

The link connection between the yoke arms **21** and the studs permits pivoting of the yoke arms in the angle of inclination between the craft **10** and tow line **11**. Studs **27** extend downwardly from the wings a sufficient amount whereby forward pulling of the craft in the water will tend to lift the craft rather than urging the craft to nose under the water as might occur if the towline attachment were too high. While the yoke arms **21** have been illustrated as attached at two points to the craft by a particular style of adjustable mounting bracket, it is to be understood and will readily appear to those skilled in the art, that the attachment could be made at one or more locations on the craft **10** and by substantially different means in order to advantageously accommodate the particular structure of a given design of craft.

The hull **12** is provided with an upper rearwardly positioned platform **33** adapted to accommodate and support the pilot P. The platform **33** may be provided with an adjustable shoe **34** of the quick-release type such as are used on water skiis, wherein the flexibility of the shoe serves to automatically release the foot upon undue strain. The shoe **34** accommodates one foot and the pilot's other foot is left free to be moved for accomplishing weight shifts for controls purposes as hereinafter described. Moreover, if personal preference dictates, the shoe **34** may be eliminated and perhaps only a friction surface provided on platform area **33** to avoid excessive slipping.

Control reins **35** are provided and have a handle **36** for gripping by the pilot P. Reins **35** include a separate element extending from each end of the handle **36** downwardly and outwardly to laterally spaced locations on the airfoil wings **13** and **14** near the leading edges of such wings. These elements of reins **35** may be either flexible or rigid such as a rope or aluminum bars with flexible connections to the airfoil wings. The reins **35** are of a sufficient length to extend substantially rearwardly to a comfortable height for gripping by the pilot P.

The operation of craft **10** is accomplished by the pilot P boarding the craft and assuming a stance on the rearward platform **33**. By means of tow line **11**, a boat pulls the craft **10** through the water with the bottom **15** of hull **12** assuming a planing relationship on the surface of the water when sufficient speed is achieved. Further increasing the speed causes the airfoil wings **13** and **14** to develop an aerodynamic lift of a sufficient magnitude to overcome the combined weight of the craft **10** and the pilot **P**, whereby the craft becomes airborne. After the craft is airborne, the tow line **11** will assume a downward angular relationship to the craft **10** as shown in FIGURES 6 and 7 with the angle depending upon the length of tow line and altitude of the craft.

The altitude and lateral position of the craft relative to the boat, is controlled and manipulated by the pilot P by shifting his weight. In this regard, it may be qualitatively illustrated that the center of gravity of only the craft **10** is approximately at point **40**, that the combined center of gravity or mass of the craft **10** and the pilot P is at points **41***a* and **41***b* in FIGURES 6 and 7 respectively, and the longitudinal center of lifting force produced by the airfoil wings **13** and **14** is at point **42**. The locations of points **40** and **42** remain the same and are a characteristic of a given craft **10**. However, since the combined center of gravity is a function of the weight and position of pilot P, this point is shifted both longitudinally and laterally in response to the pilot's movements as illustrated by the difference in position of points **41***a* and **41***b*. In normal flight, the points **41***a*, **41***b* are always behind the center of lift **42** and the towing attachment at studs **27** is usually in front of or near the center of lift **42**. This relationship results in a dynamic force diagram wherein the towline force is downward and forward in front of the upward lifting force and the gravitational force at the center of mass or gravity **41***a*, **41***b* is downward at a location behind the center of aerodynamic lift, whereby such forces of the system are resolved to a stabilized situation. For example in the relationship in FIGURE 6, the center of mass **41***a* is sufficiently far forward to produce a level flight. However, upon pilot P shifting his weight rearwardly (and perhaps downwardly by necessity) the center of mass of the system shifts to point **41***b*, thereby tending to lower the rear of the airfoil which produces a greater angle of attack between the airfoil and the air to cause the craft to climb upwardly to a higher altitude. However the higher altitude of the craft produces a greater angle of inclination of the tow line **11** thereby producing greater downward forces in front of the center of lift **42** thereby compensating for the increased moment of the downward gravitational forces as produced by the rearward shifting of the center of combined mass to point **41***b*. It is also preferred that the reins **35** be attached at least above and, if possible, slightly forward of the location of studs **27** whereby intentionally increased pulling force on the reins by pilot P (with the inherent downward push by the pilot's feet) can induce a nosing upwardly of the craft **10** for additional control purposes. For lateral turning and maneuvering of the craft the pilot merely leans sideways thereby producing both a weight shift tending to drop the airfoil wing on that side and an upward pull on the element of reins **35** attached to the opposite airfoil wing, since the pilot uses such reins to maintain his upright position. This tilting of the craft causes lateral movement similar to that caused by like tilting and leaning on conventional water skis and aquaplanes.

By adjusting the location of studs **27** in the afore-described manner, the response of the craft can be controlled for accommodating pilots of different sizes and weights which causes a shifting of points **41***a*, **41***b*. Also the control characteristics can be varied in this manner for accommodating different levels of competency of the pilots.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth or to the details illustrated in the drawings, but my invention is of the full scope of the appended claims.

I claim:

1. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a body having a pair of airfoils extending laterally outwardly on both sides at a level above the surface of the water during towing of the craft for producing substantial lifting force, means for connecting the boat tow line to said body for towing both in and above the water, said body having a rearwardly positioned upper platform for supporting the pilot substantially entirely above said body and airfoils and permitting shifting of position by the pilot, control reins connected at laterally spaced locations and extending upwardly and rearwardly for grasping by the pilot to permit leaning for control, and said airfoils having a longitudinal center of lifting force located relatively rearward of said tow line connection and substantially forward of said pilot platform for compensating and balancing the downward forces and turning moments to stabilize airborne flight and control.

2. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant body having a pair of airfoils extending laterally outwardly at a level above the surface of the water and of a shape for producing substantial lifting force upon forward motion through the air to make the craft and pilot airborne, means for connecting the boat tow line

to the front portion of said body, and said body having a rearwardly positioned upper platform for supporting the pilot above said body and relatively rearward of the longitudinal center of said air foil lifting force to permit shifting of weight by the pilot relative to the longitudinal center of said airfoil lifting force for compensating and balancing the downward forces and turning moments to control and stabilize airborne flight.

3. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair of relatively rigid airfoil wings mounted on said hull and extending laterally outwardly from each side of said hull at a level above the surface of the water upon said planing of said hull on the water, means for connecting the boat tow line to the front portion of said hull for towing both in and above the water, and said hull having a rearwardly positioned upper platform for supporting the pilot entirely above said hull and substantially rearward of the longitudinal center of said airfoil wing lifting force to permit shifting of weight by the pilot, control reins connected at laterally spaced locations to said airfoil wings and extending upwardly and rearwardly for grasping by the pilot, and said airfoil wings having a longitudinal center of lifting force located rearward of said tow line connection and forward of said pilot platform for compensating and balancing the downward forces and turning moments to stabilize airborne flight.

4. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull, a pair of relatively rigid airfoil wings mounted on said hull and extending laterally outwardly from each side of said hull at a level above the surface of the water, a yoke pivotally connecting the lower front portion of said hull to the boat tow line for towing both in and above the water, said hull having an upper platform located substantially rearwardly of the center of lifting force of said airfoil wings for supporting the pilot above and rearwardly on the craft, control reins connected at laterally spaced locations at the front of the craft and extending rearwardly and upwardly for grasping by the pilot, and said airfoil wings having a resultant longitudinal center of lifting force located between the said yoke connection and said upper platform for compensating and balancing the downward forces and turning moments caused by the pilot and craft weight and the tow line tension to stabilize airborne flight.

5. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair of relatively rigid airfoil wings mounted on said hull and extending laterally outwardly from each side of said hull at a level above said planing surface of said hull, said airfoil wings having a shape for producing substantial lifting force upon forward motion through the air to make the craft and pilot airborne, means for pivotally connecting the boat tow line to the front portion of said hull for towing both in and above the water, said hull having a rearwardly positioned upper platform for supporting the pilot above and to the rear of the said lifting force by said wings and permitting shifting of position by the pilot, and control reins connected at laterally spaced locations to said airfoil wings near the front thereof for extending upwardly and rearwardly for grasping by the pilot for support and control.

6. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair relatively rigid airfoil wings mounted on said hull and extending laterally outwardly from each side of said hull at a level above the said planing surface of said hull, said airfoil wings having a longitudinal shape for producing substantial lifting force upon forward motion through the air to make the craft and pilot airborne and having said lifting force centered relatively near the front of the craft, means for connecting the boat tow line to the front portion of said craft for towing both in and above the water, said hull having an upper platform positioned rearwardly of said center of lifting force for supporting the pilot above and to the rear of said lifting force for compensating and balancing the downward forces and turning moments caused by the pilot and craft weight and the tow line tension to stabilize airborne flight.

7. The soaring craft of claim 6 in which said airfoil wings are substantially bat-wing shape with their point of greatest lateral extension at the leading edge and tapering inwardly and rearwardly, and said hull bottom surface extending forwardly of the leading edge of the wings and extending rearwardly to substantially the intersection of the inward and rearward tapered edges of the wings.

8. The soaring craft of claim 7 in which the said upper platform is provided with a shoe member for releasably receiving one foot of the pilot and said shoe member is positioned rearwardly of the center of lifting force of said wings.

9. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair of relatively rigid airfoil wings mounted on said hull, said wings extending laterally outwardly from each side of said hull and having their point of greatest lateral extension at the leading edge and tapering inward and rearward in a bat-wing shape, said hull bottom surface extending forwardly of the leading edge of the wings and extending rearwardly to substantially the intersection of the inward and rearward tapered edges of the wings, said wings having an airfoil portion at a level above the hull bottom surface and of a shape for producing substantial lifting force upon forward motion through the air to make the craft and pilot airborne, means for pivotally connecting the boat tow line to the front portion of said hull for towing both in and above the water, said hull having a rearwardly positioned platform for supporting the pilot and permitting shifting of position by the pilot, control reins connected at laterally spaced locations to said airfoils for extending upwardly and rearwardly for grasping by the pilot to permit pilot leaning for control, and the longitudinal center of said airfoil lifting force located substantially forward but rearward of said tow line connection for compensating and balancing the downward forces and turning moments caused by the pilot-craft weight and the tow line tension to stabilize airborne flight.

10. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair of relatively rigid airfoil means mounted on said hull and extending laterally outwardly from each side of said hull at a level above the surface of the water upon said planing of said hull on the water, said airfoil means of a shape for producing substantial lifting force upon forward motion through the air to make the craft and pilot airborne, means for pivotally connecting the boat tow line to the front and lower portion of said craft for towing both in and above the water, said hull having a rearwardly positioned upper platform for supporting the pilot substantially entirely above and rearwardly of the center of said lifting forces produced by said airfoil means but permitting forward and rearward shifting of position by the pilot, control reins connected at laterally spaced locations to said airfoil means for extending upwardly and rearwardly for grasping by the pilot for support and to permit rearward and sideways pilot leaning for control, and said airfoils having a longitudinal center of lifting force located rearward of said tow line connection and forward of said pilot platform for compensating and balancing the downward forces and turning

moments caused by the pilot and craft weight and the tow line tension to stabilize airborne flight.

11. In a soaring craft to be towed on a line by a boat and controlled by a pilot, the combination of: a buoyant hull having a bottom surface of a shape for planing on the water, a pair of relatively rigid airfoil wings mounted on said hull and extending laterally outwardly from each side of said hull at a level above the surface of the water upon said planing of said hull on the water, said hull having a rearwardly positioned upper platform for supporting the pilot substantially above the craft and permitting shifting of weight by the pilot, control reins connected at laterally spaced locations to said airfoil wings for grasping by the pilot, said upper platform located a sufficient distance rearwardly and said control reins extending a sufficient distance rearwardly for preventing the pilot from shifting his location forward of the center of lifting force produced by said airfoil wings, and means

for connecting said boat tow line a variable locations on said craft relative to the center of aerodynamic lift and center of mass for producing selected responsive characteristics of said craft.

References Cited by the Examiner

UNITED STATES PATENTS

544,816	8/1895	Lilienthal	244—16
3,083,933	4/1963	Cella	244—3

OTHER REFERENCES

An article in the magazine Life, vol. 41, No. 4, July 23, 1956, p. 67.

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