Sept. 13, 1966 D. B. MacMILLAN 3,272,457

WATER SKI AUTOGYRO

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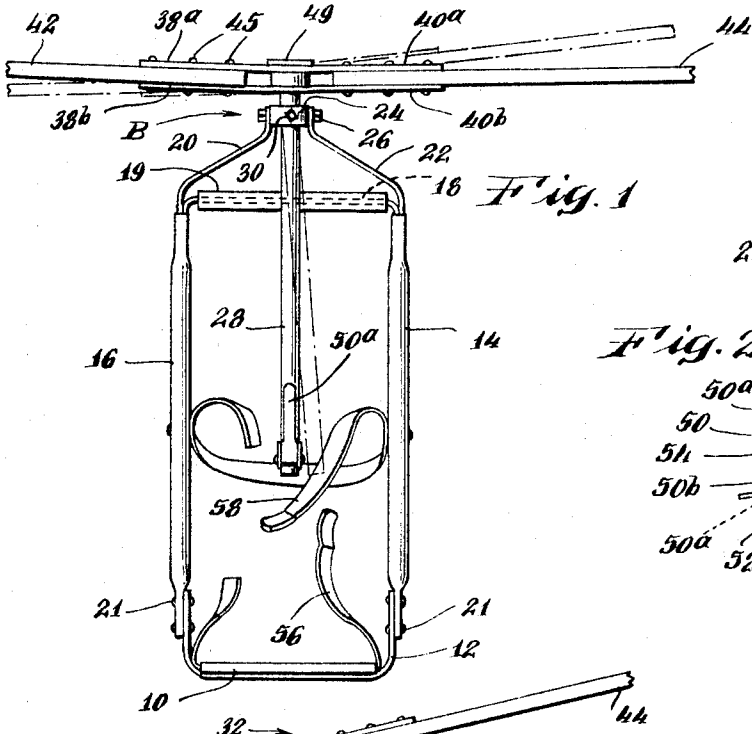


Fig. 1

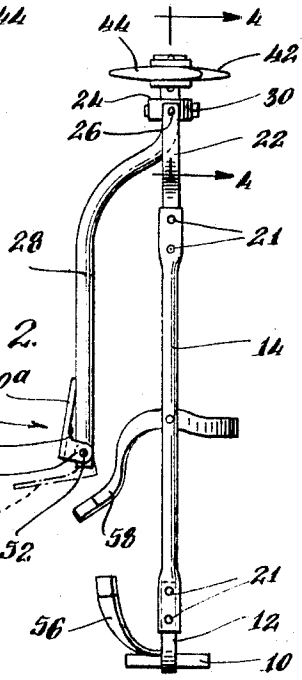


Fig. 2.

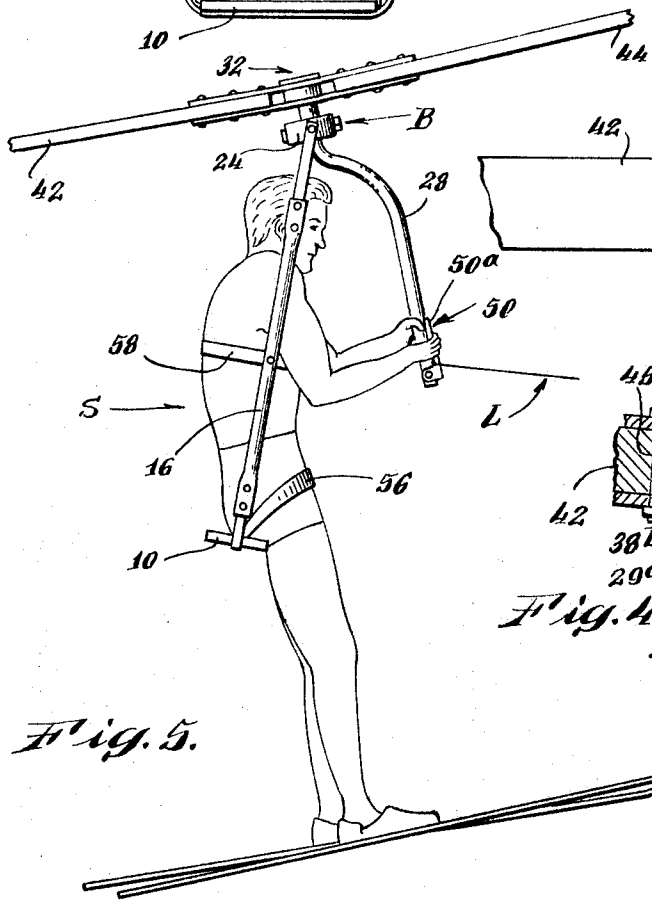


Fig. 5.

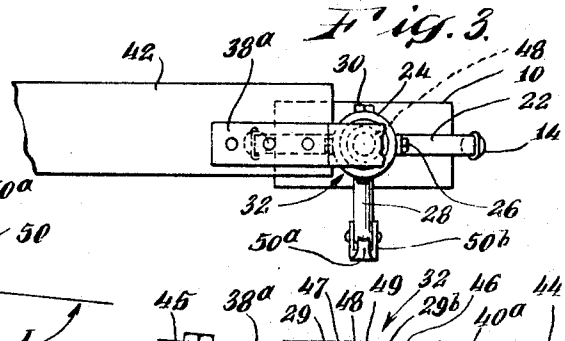


Fig. 3.

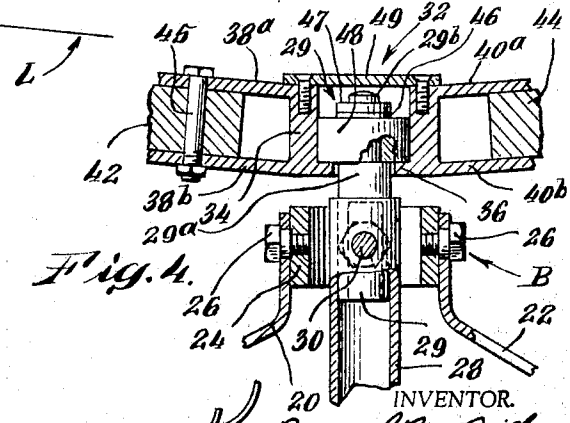


Fig. 4.

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WATER SKI AUTOGYRO

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This invention relates to sporting apparatus and is particularly concerned with a controllable autogyro for use with water skis.

Water skiing is one of the fastest growing aquatic sports. In recent years a number of attempts have been made to expand upon the sport of water skiing by introducing various types of apparatus designed to lift the skier from the surface of the water. It will be apparent that, in order for such a device to be commercially acceptable, a number of conditions must be met. First and foremost, of course, the apparatus must be safe for use by the average water skier. Also, it must be relatively lightweight, easily transportable, inexpensive, and reliable.

Apparatus heretofore proposed have been deficient in some or all of these essential characteristics. For example, a skier is usually towed on a taut line behind a speed boat regardless of the type of apparatus employed, and boats and lines are both subject to failure. If a line breaks or a boat stalls, the apparatus should allow the skier to settle gently back onto the surface of the water. The large kites which have been heretofore proposed and actually employed to lift skiers into the air do not have the pitch stability required for safety weathering such an eventuality. A kite provides lift solely because of its forward motion relative to the wind. Accordingly, these devices are extremely dangerous to the water skier in the event of a towline break or the stalling of the boat, as the skier would immediately drop into the water—possibly from a dangerous altitude.

Another type of device which has been proposed for air-lifting a water skier is the glider. A glider usually consists of a set of wings which the skier controls by body movements. While these devices are relatively free of the deficiencies inherit in a kite, they are still hazardous because they require a certain forward speed to maintain lift and return the skier to the water surface. This means that to land such a glider, one must allow for sufficient forward landing space to permit the glider to descend in its normal glide path. If the boat should stop, or the towline should break, as the skier approached a shoreline, for example, he could not prevent himself from being carried to a dangerous landing. Furthermore, the forward landing speed of a glider raises the possibility that a skier might hurtle into floating debris or even into his own boat. In addition to these deficiencies, such gliders are quite bulky, and they are also fragile and easily damaged. For these reasons, they are difficult to transport.

Devices of the helicopter type have also been proposed for use by water skiers. However, a helicopter rotor is powered and, accordingly, a heavy power plant of some type would have to be carrier. More important, however, such devices would not be safe because, in the event of power failure, the pitch of the helicopter blades would have to be reversed in order for them to autorotate and lower the skier to the surface of the water. When operating at low altitudes, there would not be

sufficient time for reversing pitch and then building up sufficient rotor speed during auto-rotation to slow the skier's fall to permit a safe landing.

Accordingly, it is a primary object of this invention to provide an improved lifting device for use by water skiers. Other objects are to provide such a device which is safe, which is easily transportable, which is light weight, and which is inexpensive. The manner in which these objects are achieved will be more apparent from the following description, the appended claims, and the figures of the attached drawings wherein:

FIG. 1 is a front view of the apparatus of this invention;

FIG. 2 is a side view of the apparatus of FIG. 1;

FIG. 3 is a top view, partially broken away, of the apparatus of FIG. 1;

FIG. 4 is an enlarged cross sectional view taken along the line 4—4 of FIG. 2; and

FIG. 5 is an illustration of the apparatus of the invention in use by a skier.

The present invention employs a fixed-pitch airfoil rotor mounted on a supporting frame work together with means for controlling the position of the rotor's plane of rotation relative to the earth. The skier's towline is fixed to the appartus by means of a simple manually releasable catch.

FIGS. 1–3 illustrate the major elements of the water ski autogyro of this invention.

The apparatus comprises a seat **10** supported in a U-shaped metal frame **12**. A left side member **14** and a right side member **16** form the sides of an open rectangular frame large enough to receive the torso and head of the user. The top of the rectangular frame is formed by a horizontal head bar **18** which is covered with a suitable padding **19**. A rotor support bracket is formed by a pair of upwardly and inwardly extending bracket members **20**, **22**. In the illustrated embodiment of the invention, all of elements **12**, **18**, **20** and **22** are flat aluminum bar stock. Side members **14**, **16** are aluminum tubes which are flattened at their upper ends to enclose the ends of head bar **18** and one end each of brackets **20**, **22**. The lower ends are flattened to engage the ends of frame **12**. Assembly of these elements is completed by means of rivets **21**. The inward ends of the bracket members are bent into vertically parallel relationship and support between them a gimbal ring **24** which is mounted on horizontal pins **26** for rotation about a first horizontal axis. A tubular control stick **28** is curved as illustrated in FIG. 2 and its upper end carries a stud **29** (FIG. 4) of relatively heavy construction having a lower portion **29***a* in the form of a hollowed-out cylinder and a reduced diameter threaded neck **29***b* which extends above the end of control stick **28**. A single fore-and-aft pivot pin **30** extends through control stick **28** and stud **29** and is secured to opposite sides of gimbal ring **24**, thus allowing the control stick **28** to pivot about a second horizontal axis perpendicular to the axis through pins **26**. It will thus be seen that the bracket members **20**, **22**, the gimbal ring **24** and the pins **26** and **30** form a gimbal bearing, designated generally as B, supporting the control stick and the open rectangular framework.

The uppermost end of the stud **29** extends through the gimbal bearing B and supports a combined rotary and thrust bearing **32** shown in FIG. 4, hereinafter referred

to as a thrust bearing. Thrust bearing 32 comprises a cylindrical bearing housing 34 which has an inwardly projecting horizontal rim 36 defining a circular opening spaced from stud 29. Extending from, and integral with, the bearing housing 34 are two pairs of rotor support bars. The first pair, 38*a*, 38*b* support one air foil 42, while the second pair 40*a*, 40*b*, support the other air foil 44. The foils are supported between the pairs of bars by means of bolts 45 which pass through the assembled structure.

An inner bearing race 46 is positioned over the reduced diameter neck 29*b* of stud 29 and rests against the shoulder formed between the large and small diameter portions of the stud. Inner bearing race 46 is retained in position by means of a tanged retainer nut 47 which is screwed over the threaded end of neck 29*b* and seated tightly against the inner bearing race 46. The outer bearing race 48 is rigidly fitted within the cylindrical housing 34 and against rim 36. Further details of the bearing are not illustrated as they are not essential to a full disclosure of the invention. Any type of rotary thrust bearing may be employed, a sealed thrust bearing employing tapered rollers has been successful, for example. The bearing assembly is closed by means of a cover plate 49 retained by means of suitable bolts.

The air foils 42, 44 which extend from the hub of this apparatus are similar in construction. Each foil is symmetrical in transverse cross section for simplicity of construction although various profiles could be employed. As the structure should be both lightweight and unsinkable, I have employed a thin aluminum sheet skin formed over a wooden stringer extending along the leading edge and containing a filling of foamed plastic. The edges of the sheet are then riveted together along the trailing edge.

The lower end of the control stick 28 is provided with a quick-release towline catch 50 comprising a handle 50*a* which lies outwardly of control stick 28 relative to the skier and is pivoted to the control stick by means of a pair of extending legs 50*b* and a pivot pin 52. The length of the legs 50*b* and the configuration of the handle 50*a* are such that a space 54 remains between the handle 50*a* and the control stick 28. This space is used to retain the towline L as shown in FIG. 5. The assembly of the apparatus is complete with a pair of safety belts—a seat belt 56 and a chest strap 58 provided with quick release buckles of the aircraft type.

To use the apparatus, a water skier buckles himself into the straps in the manner shown in FIG. 5. Due to the relatively light weight of the apparatus and its buoyancy, this may be done without difficulty. The skier is partially seated on seat 10 and presses his head upwardly against the padding 19 of head bar 18 to stabilize the structure. The towline L from a speed boat is passed around the handle 50*a* of towline catch 50. The handle 50*a* is then pivoted upwardly against control stick 28 and held by the skier's hands as shown in FIG. 5. As the boat begins to pull the skier through the water, he rises up on his skis in the usual manner, using the control stick 28 in lieu of a towline bar. As the skier begins to pick up forward speed in the water, he may allow the lower end of the control stick 28 to be pulled forward, thus tipping the plane of rotation of the air foils 42, 44 causing them to rotate about the thrust bearing 32. As the speed of rotation of the air foils increases, they begin to exert a lifting force upon the rectangular frame work until it and the skier are lifted completely off the water. The skier is thereafter airborne and can control both his height and lateral movement by suitable maneuvering of the control stick 28.

The use of a gimbal bearing makes it possible for a skier to control his direction of flight, as well as his altitude, within the confines of his towline. Accordingly, he may swoop from side to side and perform other maneuvers. He may also control the direction of his descent after releasing the towline in the air.

An air foil rotational speed sufficient to lift the skier from the water is also sufficient to allow him to descend safely. Since this device is of the autogyro type, the direction of air foil rotation remains the same for both ascents and descents. Accordingly, if the towline should part, or the boat stall, the skier will descend immediately at a safe rate of descent.

The disclosed apparatus is not only safe and simple in construction but is also easily portable. The length of the rotors is not critical but, in one embodiment, each is approximately eight feet in length. The apparatus may be stowed on the roof of a station wagon by inverting the assembly so that the cover plate 49 is down. The rectangular framework then pivots about the gimbal bearing B and lies alongside the rotors, the handle 28 extending upward. The length can be radically shortened by unfastening one of the rotors by removing bolts 45.

It will be apparent to those skilled in the art that a number of variations and modifications may be made in the apparatus of this invention without departing from its spirit and scope. Accordingly, it is to be understood that the foregoing description is illustrative only, rather than limiting. The invention is limited only by the scope of the following claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A towable lifting device which comprises: a generally rectangular framework including a seat member, right and left side members extending upwardly from said seat member, and an upper cross member interconnecting said side members; a right rotor support member having a first end connected to said right side member and extending upwardly and inwardly therefrom; a left rotor support member having a first end connected to said left side member and extending upwardly and inwardly therefrom; universal mounting means supported by the second ends of said rotor support members; a plurality of elongated air foil means supported by said universal mounting means for rotation about a tiltable axis; control stick means having a first end in operating relationship to said universal mounting means to tilt said tiltable axis and a second end depending from said universal mounting means; and a towline latch mounted on said control stick at its second end and arranged to be grasped by a user for releasably retaining a towline therein.

2. The device of claim 1 wherein said control stick extends forwardly and downwardly from said universal mounting means so that its second end is forward of a user seated in said seat member.

3. The device of claim 1 wherein said towline latch comprises an elongated hand grip having a first end pivoted to said control stick and a second end foldable against said control stick on the side away from said user, said hand grip and control stick defining a towline-receiving opening therebetween.

4. A towable lifting device for water-skiers which comprises: a generally rectangular framework including a seat member, right and left side members extending upwardly from said seat member, and an upper cross member interconnecting said side members; a right rotor support member extending upwardly and inwardly from said right side member to an upper end; a left rotor support member extending upwardly and inwardly from said left side member to an upper end, the upper ends of said right and left rotor support members extending vertically in spaced parallel relationship to one another; a gimbal ring pivotally mounted between the second ends of said rotor support members for rotation about a first axis substantially parallel to the plane of said rectangular framework; a control stick pivotally mounted within said gimbal ring for rotation about a second axis substantially normal to said first axis, a first end of said control stick extending above said gimbal ring and a second end of said control stick depending below said gimbal ring; rotatable thrust bearing means mounted on said first end of said control

stick; a plurality of elongated air foil means extending outwardly from said thrust bearing means for rotation thereabout; and a towline latch mounted on said control stick at its second end and arranged to be grasped by the user for releasably retaining a towline therein.

5. The device of claim 4 wherein said control stick extends forwardly and downwardly from said gimbal ring so that its second end is forward of a user seated in said seat member.

6. The device of claim 5 wherein said towline latch comprises an elongated hand grip having a first end pivoted to said control stick and a second end foldable against said control stick on the side away from said user, said hand grip and control stick defining a towline-receiving opening therebetween.

7. The device of claim 6 wherein said air foil means are buoyant in water.

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