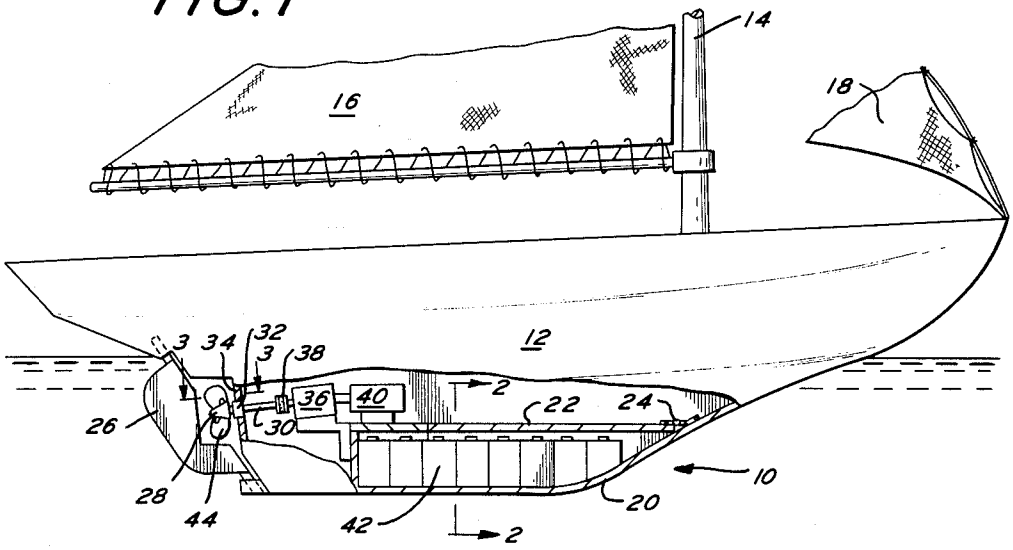
March 8, 1966 L. PAZULSKI 3,238,911

AUXILIARY SAIL BOAT

Filed June 11, 1964

FIG. 1



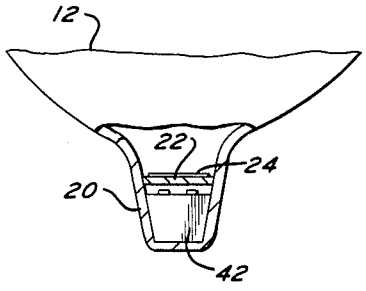




FIG. 2

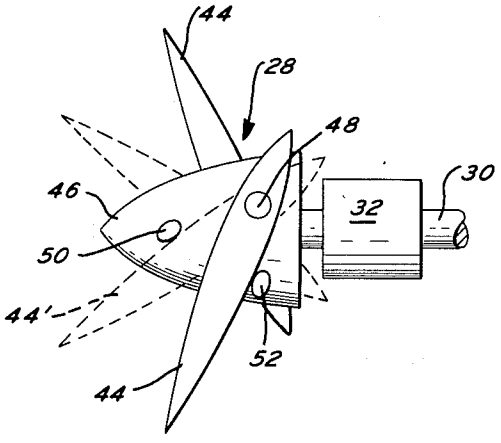



FIG. 3

INVENTOR
LUCIAN PAZULSKI

BY Seidel & Gonda

ATTORNEYS.

United States Patent Office

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# AUXILIARY SAIL BOAT

Lucian Pazulski, 59th and Elmwood Sts., Philadelphia, Pa.

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11 Claims. (Cl. 114—39)

This application relates to an auxiliary sailboat. More particularly, it relates to a sailboat provided with motive power to drive it when the wind fails to maintain its velocity above a predetermined level.

A sailboat is by its nature subject to the vicissitudes of the weather. Under extreme conditions such as gale force winds or no wind at all a sailboat cannot use its primary source of power, the wind. In the one case the wind cannot be safely harnessed and in the other case it is not available. For this reason it is necessary to provide a sailboat with an auxiliary form of motive power which may be employed when whether conditions do not permit the use of wind to propel the boat.

Although a gasoline or diesel engine may be used as an auxiliary engine in sailboats, engines of this type have certain disadvantages. Such engines require that a space consuming supply of fuel be carried aboard the sailboat. Further, once the fuel supply is exhausted it cannot be replenished except by moving the boat into a port with facilities for so supplying the boat. Further, on long trips the consumption of fuel can be particularly critical when the engine is used to drive additional equipment such as electrical current generators for the lighting. Fuel consumed for such additional purposes cannot be replaced, and thus will not be available to drive the boat if an emergency should arise.

Therefore, it is the general object of this invention to provide a novel means of motorizing a sailboat that avoids the disadvantages indicated above.

It is another object of this invention to provide a novel electro-mechanically motorized sailboat.

It is still another object of this invention to provide a novel motorized sailboat that replenishes its energy source when under sail.

It is a further object of this invention to provide an auxiliary sailboat that automatically switches on the motor to drive the boat when its velocity falls below a predetermined level.

It is yet another object of this invention to provide a sailboat with a novel means of storing its source of motive energy.

It is another object of this invention to provide an auxiliary sailboat with a novel propeller.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a plan view of a sailboat with a portion of its hull cut away to show the auxiliary driving means.

FIGURE 2 is a partial transverse view of the sailboat shown in FIGURE 1 taken along the line 2—2.

FIGURE 3 is a longitudinal view of novel propeller used on the auxiliary sailboat shown in FIGURE 1 taken along the line 3—3.

Referring now to the drawing, wherein like numerals indicate like elements, there is shown a motorized sailboat designated generally as **10**. As shown in FIGURE 1 the sailboat comprises a hull **12** upon which is mounted an upright mast **14**, supporting a main sail **16** and a jib sail **18**. The hull **12** is provided with a hollow keel **20** which extends longitudinally along a substantial portion of the lowermost part of the hull **12**. A cover **22** is pivotally



attached to the hull **12** by means of a hinge **24** or other pivotal connecting means. Thus, when cover **22** is closed a hollow chamber is provided in keel **20**. At the stern of the sailboat **10** a rudder **26** is pivotally mounted on a hull **12**. Steering means (not shown) control the position of the rudder **26** and therefore the direction in which a sailboat **10** will travel.

Also mounted on the stern of the boat is a propeller indicated generally as **28**. As will be explained further on, the propeller **28** is of a somewhat modified form. However, but for the modification, it is constructed in the same manner as other propellers of the type used to drive a boat forward when rotated. Propeller **28** is mounted on a shaft **30** which extends through a housing **32** mounted in the stern board **34**. Shaft **30** is coupled to a motor-generator **36** by means of a coupler **38**.

Motor-generator **36** is a direct current electro-magnetic rotating machine, which by proper polarization of its armature and stator windings can be used either as a motor or a generator. Rotating machinery of this type is commercially available and therefore need not be described in detail. A switching mechanism **40** is provided to selectively polarize the armature and stator of said motor-generator **36** according to the desired function.

Energy to drive the motor-generator **36** when it is used as a motor is provided by a plurality of batteries **42** securely mounted in keel **20**. Batteries **42** are of the secondary or rechargeable lead-acid type. They may be hermetically sealed against the effects of bilge water. The batteries **42** are electrically connected to motor-generator **36** through switching mechanism **40**.

In the typical sailboat the space within the keel **20** occupied by batteries **42** is ordinarily filled with a heavy ballast such as lead. It is the function of the keel **20** and its ballast to stabilize the boat and prevent drifting. This important function is accomplished herein by using the batteries **42** as ballast. Thus, what was heretofore deadweight and represented a loss of storage capacity has been put to use as a storage compartment for the boat's auxiliary motor energy supply. This is accomplished without sacrificing any part of the function of the keel **20**.

The weight of the ballast ordinarily represents 25–50% of the boat's total displacement. The weight of the batteries **42** in the present invention readily provide the necessary ballast. Thus, a typical 27 foot auxiliary sailboat will displace 6000 lbs. Of the 6000 lbs., 2500 lbs. would be represented by lead ballast, with an additional 500 lbs. being represented by the weight of a gasoline engine, its fuel supply, and battery. In accordance with this invention the 2500 lbs. of lead ballast is replaced by 2900 lbs. of battery ballast and a 100 lb. D.C. motor-generator unit. Since the batteries can provide approximately 25 watt hours per pound, their total capacity is 72.5 kilo-watt hours. This is enough energy to run a 5 horse power electric motor for 20 hours, which corresponds to a range of 100–150 nautical miles.

When motor-generator **36** is functioning as a motor it turns propeller **28** to drive the boat forward. This, of course, will deplete the energy stored in batteries **42**. However, the used energy can be restored by operating the motor-generator **36** as a generator supplying a recharging current to the batteries **42**. The recharging of the batteries **42** can be done while the boat is under sail.

As the wind drives said boat **10** water will flow past hull **12** and around the blades **44** of propeller **28**. This action will cause propeller **28** to rotate thereby turning motor-generator **36**. If motor-generator **36** is energized as a generator it will generate an electric current sufficient to recharge the batteries **42**.

As a part of this invention propeller **28** has been constructed for efficient service both as a driving means and

as a driven means. Accordingly, propeller **28** comprises the hub **46** upon which propeller blades **44** are mounted. As shown in FIGURE 3, blades **44** are pivotally mounted on hub **46** by means of a pin **48** formed with or otherwise fixed to each blade and rotatably secured to hub **46**.

A pair of stops **50** and **52** project from hub **46** a distance sufficient to contact a side of the blades **44**. In this manner, stops **50** and **52** provide a means to limit the angle through which the blades can rotate. Although two blades **44** are shown, it is to be understood that 3 or more can be used if necessary.

When the propeller **28** is being driven by motor-generator **26** blades **44** will rest against stop **52**. This is a necessary result caused by the reaction force as the blades push against the water to drive the boat forward. On the other hand, when propeller **28** is driving motor-generator **36** the blades **44** will rest against stop **50**, as indicated by the blades **44** prime shown in phantom. Blade **44** is caused to rest against stop **50** by the force of the water as it flows past propeller **28**.

As thus described, propeller **28** is in effect a variable pitch propeller. In its driving position it has a smaller angle of attack than it has in its driven position. As is understood by those skilled in the art, the larger angle of attack enables the propeller to be more easily rotated by the water as it flows around the blades. In this manner sufficient mechanical advantage is provided to drive the motor-generator **36** in its generating function.

As indicated above, switching mechanism **40** is provided to properly energize the rotor and stator of motor-generator **36** according to the function desired. This is done automatically according to the velocity of the sailboat **10**. Although not limited thereto, switching mechanism **40** may be a tachometer switch mechanically coupled to the rotor of motor-generator **36**.

Switching mechanism **40** is set so that when boat **10** is driven by the wind at a velocity above the predetermined figure (4 knots for example) it will switch the motor-generator **36** to its generating function and thereby charge batteries **42**. Should the wind fall off sufficiently, so that the speed of the boat is below a predetermined velocity (3 knots for example), then the switching mechanism **40** switches the motor-generator **36** over to its motor function. The velocity gap between the motor function and generating function is provided to avoid hunting when the boat is moving at a speed close to the change over velocity. The speeds given are by way of example and should in no way be considered as limiting.

Since the speed of rotation of the motor-generator rotor is directly proportional to the speed of the boat, the tachometer switch can be calibrated to initiate the switching action at predetermined velocities. An override switch (not shown) may be provided so that the motor-generator **36** will function only as a motor, only as a generator, or be completely shut down.

From the foregoing it may be seen that a novel sailboat with an auxiliary engine has been provided. Said sailboat has a long cruising range when under auxiliary power, and it does not require that valuable storage space be provided for fuel. This is accomplished by using batteries in the dual capacity of providing both motor energy and ballast. The sailboat, according to this invention, is capable of maintaining a high average speed by automatically switching from wind power to auxiliary power. Further the sailboat uses rechargeable batteries, thus prolonging the amount of time which it can remain away from a port. Also, the sailboat disclosed herein has been provided with a novel propeller with partially rotating blades to facilitate the operation of the motor-generator **36**.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:



**1.** An auxiliary sailboat comprising a hull, mast means supported by said hull, said means supported by said mast, said mast means and sail means cooperating to propel said hull using wind energy, a hollow stabilizing keel integral with said hull, electrical battery means within said keel, a propeller mounted on said hull and keel, said propeller having a rotatable shaft extending therefrom, motor-generator means coupled to said propeller shaft, means for electrically connecting said motor-generator means with said battery means, said electrical connecting means including velocity responsive switch means coupled to the rotor of said motor-generator, said velocity responsive switch means being adapted to switch said motor-generator means to battery charging operation when the wind propels the sailboat above a predetermined velocity and to switch said motor-generator means to propeller driving operation when the wind propels the sailboat below a predetermined velocity.

**2.** An auxiliary sailboat in accordance with claim **1** wherein said battery means is the ballast for the sailboat.

**3.** An auxiliary sailboat in accordance with claim **1** wherein said battery means is a plurality of electrically interconnected, hermetically sealed, lead-acid batteries.

**4.** An auxiliary sailboat in accordance with claim **1** wherein said propeller comprises a hub, a plurality of propeller blades freely, pivotally mounted on said hub, and stop means for each propeller blade mounted on said hub to limit the degree of blade rotation.

**5.** A sailboat adapted to automatically use wind energy at speeds above a predetermined velocity and use electromechanical energy at speeds below a predetermined velocity comprising a hull, sail means mounted on said hull adapted to use wind energy to propel said sailboat, a stabiliizing keel mounted on said hull, battery means in said keel, a motor-generator, a propeller mounted on said hull and rotatably coupled with said motor-generator, and velocity responsive switching means for electrically connecting said motor-generator to said battery means, said switching means being coupled to the rotor of said motor-generator for automatically connecting said battery means as a function of the rotational velocity of said rotor to energize the motor-generator to charge said batteries when said sailboat is being propelled by the wind above a predetermined velocity and for automatically connecting said motor-generator to said battery means to energize said motor-generator for motor operation to drive said propeller when said sailboat is propelled below a predetermined velocity.

**6.** A sailboat in accordance with claim **5** wherein said battery means comprises the ballast for said keel.

**7.** A sailboat adapted to automatically use wind energy at speeds above a predetermined velocity and use electromechanical energy at speeds below a predetermined velocity comprising a hull, said hull including a stabilizing keel, sail means mounted on said hull, a propeller rotatably mounted on said hull, motor-generator means rotatably coupled to said propeller, battery means electrically connected to the motor-generator means, means including velocity sensitive switching means for connecting said battery to the motor-generator means, said velocity sensitive switch means being coupled to and responsive to the velocity of the motor-generator rotor so that at speeds below said predetermined velocity said switching means switches said motor-generator means to motor operation using the stored electrical energy in said battery means to drive said propeller and at speeds above said predetermined velocity said switching means switches said motor-generator to generating and battery charging operation using the energy of water flowing past the propeller to turn said generator.

**8.** The sailboat in accordance with claim **7** wherein said propeller comprises at least two propeller blades axially rotatably mounted on a hub, said blades being freely rotatable and stop means projecting from said hub to limit the axial rotation of said blades.

**9.** A sailboat in accordance with claim **8** wherein said

stop means limit the rotation of said blades to a small angle of attack when said motor-generator is in its generating operation and to a large angle of attack when said motor-generator is in its motor operation.

**10.** A sailboat in accordance with claim **7** wherein said battery means provides the ballast for said keel.

**11.** A sailboat according to claim **7** wherein said battery means comprises a plurality of electrically interconnected, hermetically sealed, lead acid batteries.



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FERGUS S. MIDDLETON, *Primary Examiner.*

MILTON BUCHLER, *Examiner.*