Feb. 4, 1941. W. O. BENJAFIELD 2,230,398

AEROTURBINE PROPELLER

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Fig. 1.

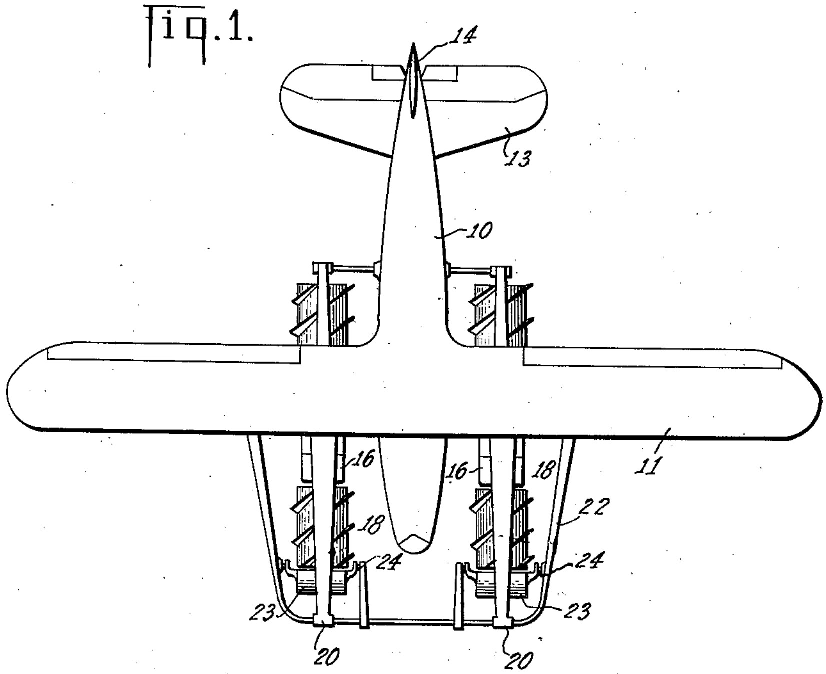
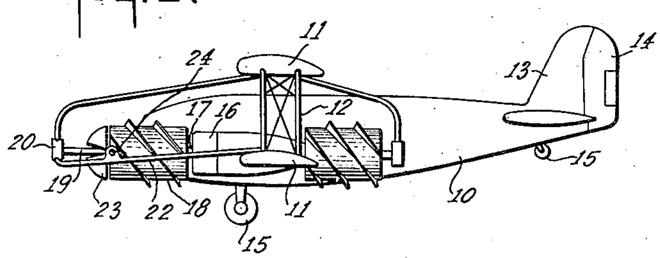


Fig. 2.



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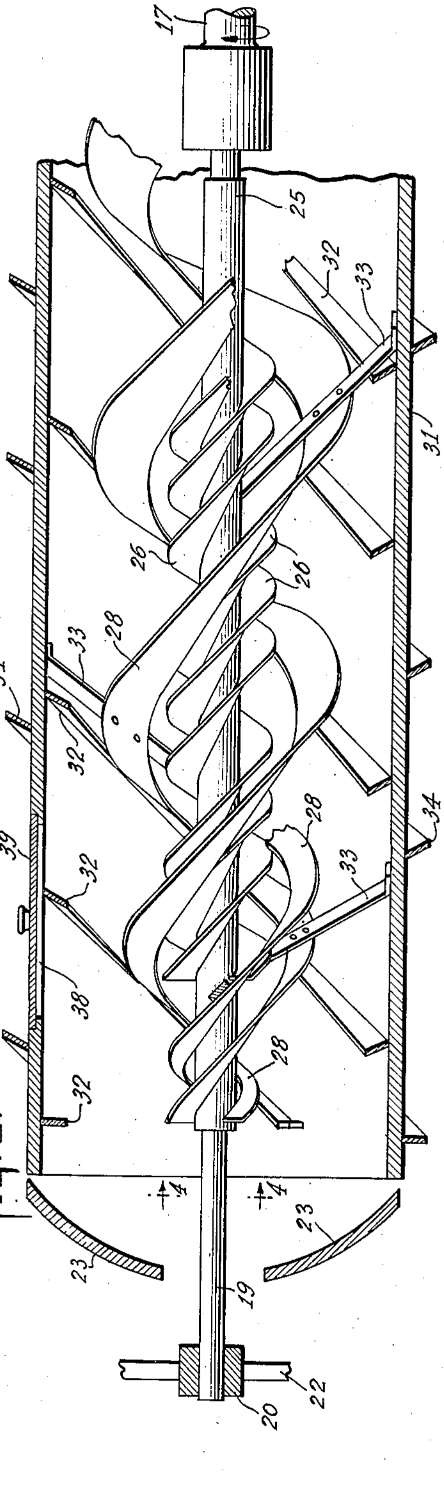

Fig. 3.

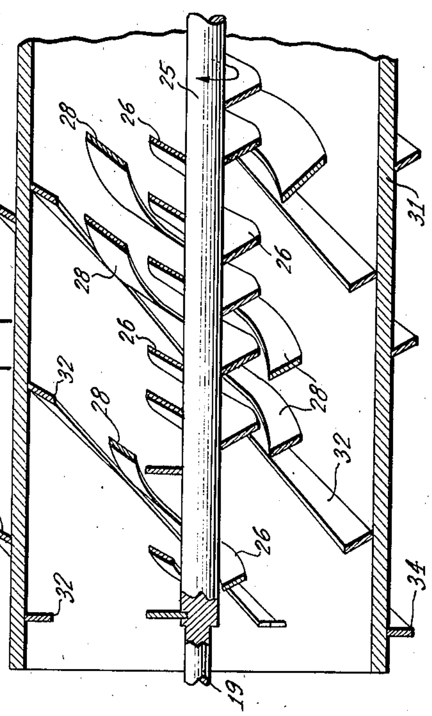

Fig. 5.

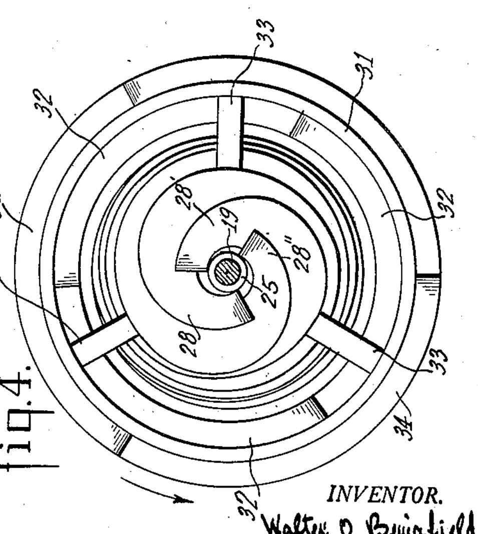

Fig. 4.

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Fig. 6.

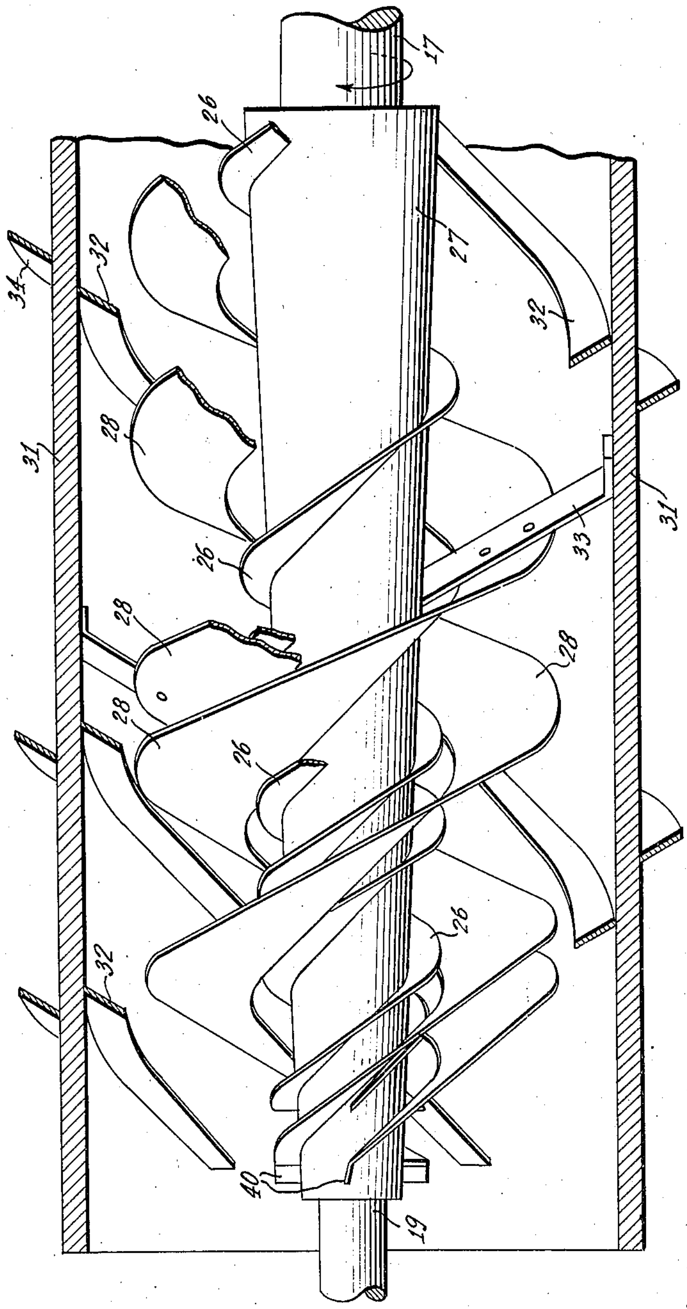

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Fig. 7.

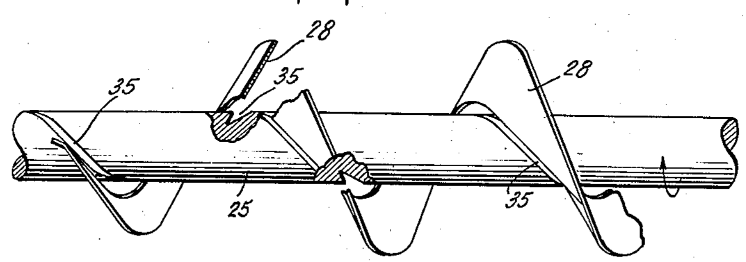


Fig. 8.

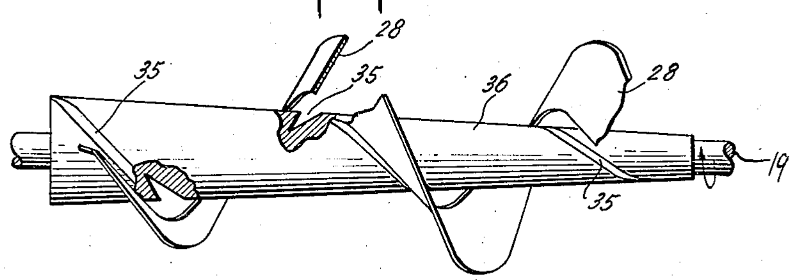
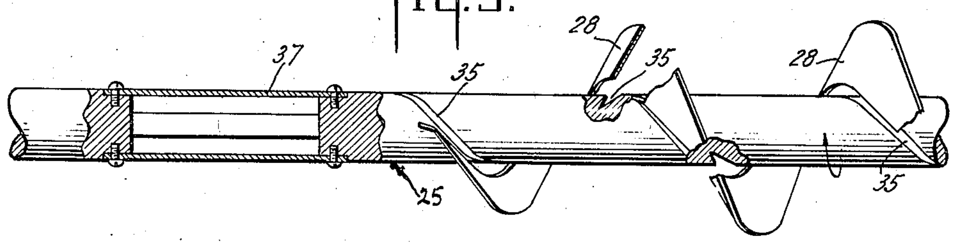


Fig. 9.



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Patented Feb. 4, 1941

2,230,398

UNITED STATES PATENT OFFICE

2,230,398

AEROTURBINE PROPELLER

Walter O. Benjafield, New York, N. Y., assignor to Clifford Yewdall, Great Neck, N. Y.

Application September 29, 1937, Serial No. 166,249

10 Claims. (Cl. 170—156)

This invention relates to aeroturbine propellers. A principal application of these aeroturbine propellers is to the propulsion of aircraft in which the propellers are rotated by means of motors, such as gasoline or oil engines.

The propulsion of airplanes is now effected by a propeller comprising a plurality of blades, spaced equidistantly radially and fixed on a hub which is usually fixed on a central shaft rotated by a gasoline or oil motor. Among the objections to blade propellers are, first, the danger of fatalities or casualties from the exposed rotating blades; second, the relatively small amount of atmosphere intercepted by the blades; and third, the air resistance and the creation of suction at the rear edges of the blades which tends to retard their rotation. Other objections to blade propellers are known in the art.

A phenomenon has long been known in the science of meteorology, manifest in cyclones or tornadoes, in which the rotation of the wind in spiral paths of relatively small diameter effects a greatly magnified force so that small sticks or straws have been driven into wooden posts or telegraph poles and embedded therein. My invention is primarily a device so constructed that when rotated in the atmosphere at high velocity a greatly magnified force is created which is directed along the axis of rotation. By mounting my device on an airplane I produce a greatly magnified force in the path of travel of the airplane. Any of the motors operated by gasoline or oil and now used in aeronautics, preferably those of a high number of revolutions per minute, may be connected with my device to rotate it at high velocity, the device being directly connected to the motor shaft or through interposed gearing. My device may be positioned in front of the motor, in the rear of the motor, or at one side, or a plurality may be used in different positions, equilibrium and distribution of weight being determined by general considerations of design in the construction of the airplane. A minimum of adjustment in the design need be effected when my aeroturbine propellers are installed in any of the bi-motored or bi-propeller airplanes. In one embodiment of my invention three spiral coils formed of flat metal are symmetrically mounted on a central shaft; the coils overlap; intermediate supporting blades may be inclined like the faces of the coils and be mounted on the shaft; the shaft and a motor may be connected; a fourth spiral may be mounted directly on and contiguous to the shaft. An important factor is the symmetrical distribution of parts about the shaft. A model so constructed and attached by me to the shaft of an electrical motor, having a load rating of 4500–5000 R. P. M., developed many times the power developed by a model of a three-blade propeller of the usual airplane design and of related size when mounted on the same electrical motor shaft. The central shaft may be tapering or conical in form, designed to displace any vacuum tending to be created by the rotative air, and undercut forwardly for greater push.

Each of the spiral coils has this property, namely, that it intercepts a particle of air rotated from the center of the spiral as a starting point and continually and repetitiously deflects this particle of air rotatively and to the rear from the point of the spiral. Similarly all other particles of air are deflected rotatively and to the rear. A spiral coil having this property may be formed by cutting a continuous spiral from a plane disk and drawing back the spiral along the perpendicular axis of the disk so that the outer edge of the spiral lies in part substantially in a geometrical cone. The effect of the foregoing construction is to accelerate each rotative particle of air to increase the force of its resistance to deflection thereby producing an enhanced reacting force in the spiral coil along the axis of the spiral toward the starting point. The air is compressed by rotation because of the centrifugal force and therefore its elasticity is increased as it is subjected to repeated blows or pressure from the blade of each spiral coil, and I believe I am the first inventor to increase the cushioning effect of the air encompassed by a spiral propeller rotated at high velocity to increase the force above the normal air resistance to the ordinary screw propeller heretofore known in the art. By employing three equally and radially disposed spirals I substantially and efficiently employ the entire body of air intercepted by the plane perpendicular to the axis of the spirals whose perimeter is defined by lines perpendicular to this plane tangential to the outer edges of the spirals. It will be understood that the duplication in practice of a theoretically perfect miniature tornado or cyclone is rarely possible and only during the coincidence of all favorable factors so that the similitude is substantial but not practically complete, the air not acted upon in the basic way being however utilized by a compensating structural arrangement of parts. To provide for this automatic compensation within the device certain clearances may be left between the spirals and between the spirals and the spiral on the shaft and the internal spiral on the cylinder so that air may pass between and adjust itself to variations, but still tend to augment the power developed by my aeroturbine propeller.

When my aeroturbine propeller is mounted on an airplane, as the airplane moves forward into the air, the air enters the aeroturbine propeller with increasing velocity as the airplane gains speed. The screw end of each spiral encompasses a new body of air, the air is encaged within the turbine, given repeated blows by the rotating spiral blades, and compressed to increase the impact force of the rotating spiral blades, so that the effective force of the air is greatly magnified. The outside spiral mounted on the outside of the casing acts as a continuous screw propeller.

A shutter may be mounted in front of the aeroturbine propeller to cut off a part of or all of the air normally encompassed by the spirals to regulate the aeroturbine propeller. This shutter may be constructed as automatic in operation or may be manually controlled from the cabin of the airplane.

A battery of my aeroturbine propellers may be used, a part being put to use and a part cut out selectively, or one or more may be used in association with the present blade propellers. Aeroturbine propellers of different design or rating may be installed on the same airplane.

Figure 1 is a plan view showing four of my aeroturbine propellers installed on a bimotored biplane.

Figure 2 is a side elevation of the structure shown in Figure 1.

Figure 3 is a lengthwise view, partly in section, showing a shaft bearing and an adjustable shutter at the left end, a motor shaft at the right end adapted to rotate in the direction of the arrows, two of the intermediate centrifugal spirals broken out to show one intermediate centrifugal spiral blade of theoretical design.

Figure 4 is an end view on the line **4—4** of Figure 3.

Figure 5 is a side view similar to Figure 3 but with all the coils sectioned.

Figure 6 is a lengthwise view partly in section with the blades of the centrifugal coils widened over the theoretical form shown in Figure 3.

Figure 7 is a modification showing a central shaft having spiral undercut grooves, only one coil and groove shown.

Figure 8 is a modification showing a central shaft tapering from left to right, only one coil and groove shown.

Figure 9 is a modification showing an air chamber formed in the central shaft toward the front, only one coil and groove shown.

As shown in Figures 1 and 2, a fuselage **10** of a bimotored biplane has two wings **11** supported on the frame **12**, the usual tail **13**, a rudder **14**, and landing gear **15**. Rotary engines **16** are mounted one on each side of the fuselage **10** and support on their central shafts **17** the aeroplane propellers **18**, which are designed to turn to the right looking toward the front of the propellers **18** from the rear. Each aeroturbine **18** has an axial central shaft **19** supported in a front bearing **20** and mounted on the central motor shaft **17**. The bearing **20** is supported rigidly on a frame **22** comprising several arms. A shutter **23**, automatic or controlled from the cabin of the airplane, is pivoted at **24** on the frame **22** and may be opened or closed over the front end of each aeroturbine **18**. Two aeroturbine propellers **18** are shown on each side of the fuselage **10**, one in front and one in the rear of each motor or engine **16**.

Starting near the front and hugging the central portion of the shaft **19** are three spiral blades **26**, each blade **26** turning as viewed looking from the rear towards the front in a clockwise direction about the central portion **25** of the shaft **19**, the blades **26** moving the air rearwardly as the shaft **19** is rotated. The blades **26** are spaced equidistantly around the shaft. As shown in Figure 6 the central portion **25** may be a tapered cone **27**. As shown in Figures 3 and 4 three spiral blades **28**, **28'**, and **28''** are mounted around the shaft **19** but spaced therefrom and from the spiral blades **26**. The blades **28** start at the front of the central portion of the shaft **19**. Each blade **28** turns forwardly in a clockwise direction about the shaft **19** and the rear blade face slopes forwardly toward the axis of the shaft. The three blades **28** are spaced equidistantly radially and the outer edges of the blades overlap the inner edges of adjoining blades. Two of the blades **28** are broken away clearly to show the structure of a single blade **28** and the blades are formed to show the theoretical design essential to a centrifugal action on the encompassed air; but in practice the blades **28** are widened to utilize all the pressure forces on the available air, as shown in Figure 6.

A cylinder **31** is concentric with the shaft **19** and fixed to the shaft and on the inner surface has a plurality of spiral blades **32** turning forwardly in a clockwise direction and effective to drive the air rearward when rotated to the right. The blades **32** are spaced slightly from the blades **28** to permit an automatic adjustment of air pressures within the cylinder **31**.

The shaft **19**, the blades **26**, **28**, and **32** are fixed and secured by connecting supports **33** also fastened to the cylinder **31**. These supports **33** are also in the form of blades and are inclined substantially in parallel with the spirals to which they are attached so that their rear faces act as propellers.

Surrounding the outer wall of the cylinder **31** are a plurality of spiral blades, **34**, turning forwardly in a clockwise direction with the rear faces sloping forwardly in a direction toward the axis of the cylinder, which serve to reduce air resistance and to augment the driving power of my aeroturbine propellers.

Various modifications may be made. As shown in Figure 7 undercut grooves **35** are formed in the shaft **19** in the central portion **25** counterpositioned with reference to blades **28**. As shown in Figure 8 a shaft **19** has a central portion **36** tapering from left to right. As shown in Figure 9 a central aperture or air chamber **37** is formed in the central portion **25** of the shaft **19** toward the left or front end. This chamber may be similar to a barrel with alternate staves broken out and increases the air supply. As shown in Figure 3 an aperture **38** may be formed in the cylinder **31** and the size of the opening varied by a closure **39** to regulate air-intake. As shown in Figure 6 the extreme front ends **40** of the spiral blades **28** may be turned on an angle with reference to the axis of the shaft.

Variations may be made in the form, pitch, inclination, number, and size of the spiral blades, parts may be omitted, sizes may be varied, the length may be varied, and blades may be made integral or in parts.

I claim:

1. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally to produce resultants of centrifugal and rearward molecular forces reacting forwardly, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated.

2. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the similar rearwardly inclined spiral blades being symmetrically disposed about and along the axis of the shaft in such a way that the outer edge of one spiral overlies the inner edge of the part of the spiral next to the rear with reference to a perpendicular plane intercepting the axis of the shaft.

3. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the similar rearwardly inclined spiral blades being symmetrically disposed about and along the axis of the shaft in such a way that the outer edge of one spiral overlies the inner edge of the part of the spiral next to the rear with reference to a perpendicular plane intercepting the axis of the shaft, and each blade being widened towards the rear starting a short distance from the front.

4. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the similar rearwardly inclined blades being symmetrically disposed about the shaft, and a plurality of spiral walls mounted on the shaft, and symmetrically disposed about the axis of the shaft being interposed axially between the first series of spiral blades.

5. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the similar rearwardly inclined blades being symmetrically disposed about the shaft, and a cylindrical casing mounted on the shaft so as to surround the spiral blades.

6. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of the blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, and a cylindrical casing mounted on the shaft and surrounding the spiral blades, and symmetrically disposed spiral blades mounted on the outside wall of the cylindrical casing.

7. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals en-

compassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of the blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, and a shutter positioned at the front of the shaft for controlling the quantity of air intercepted by the spiral blades.

8. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the shaft being conical in form.

9. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, and spiral undercut grooves being provided in the shaft.

10. An aeroturbine screw propeller comprising in combination, an axial shaft and a plurality of rearwardly inclined spiral blades symmetrically and equidistantly mounted on said shaft and including a plurality of turns, each succeeding turn being substantially displaced along the shaft, in the form of similar spirals with the outer edges inclined to the rear away from the inner edges and in every cross-section the spirals encompassing the shaft peripherally, the inner edges being increasingly removed from the axis of the shaft towards the rear, an annular lengthwise passage being provided between the spiral blades and the shaft after the initial turn of said blades, the structure being such that molecules of air are repetitiously intercepted and directed outwardly and rearwardly with increasing centrifugal force and velocity as each spiral is rotated, the shaft being conical in form and spiral undercut grooves being provided therein.

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