(Model.)

2 Sheets—Sheet 1.

J. M. ADAM.

SCREW PROPELLER.

No. 602,651. Patented Apr. 19, 1898.

Fig. 1.

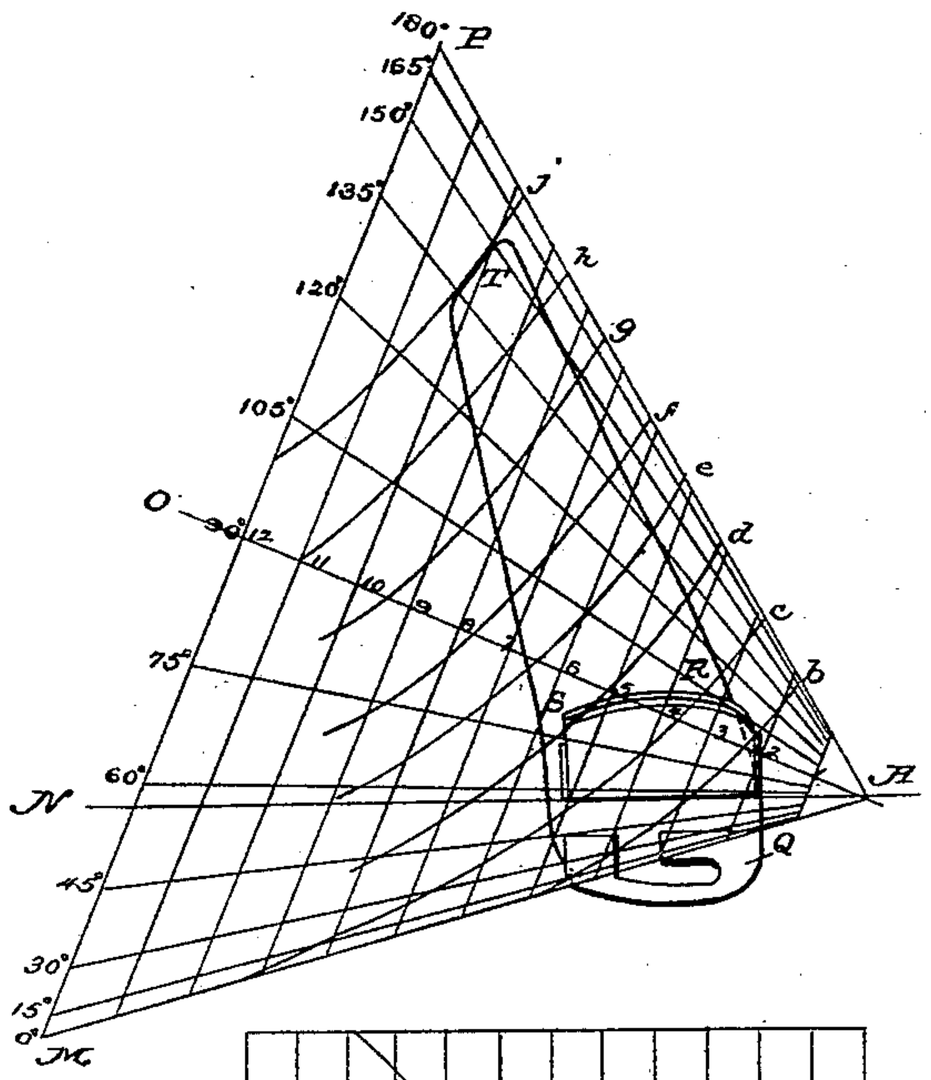


Fig. 3.

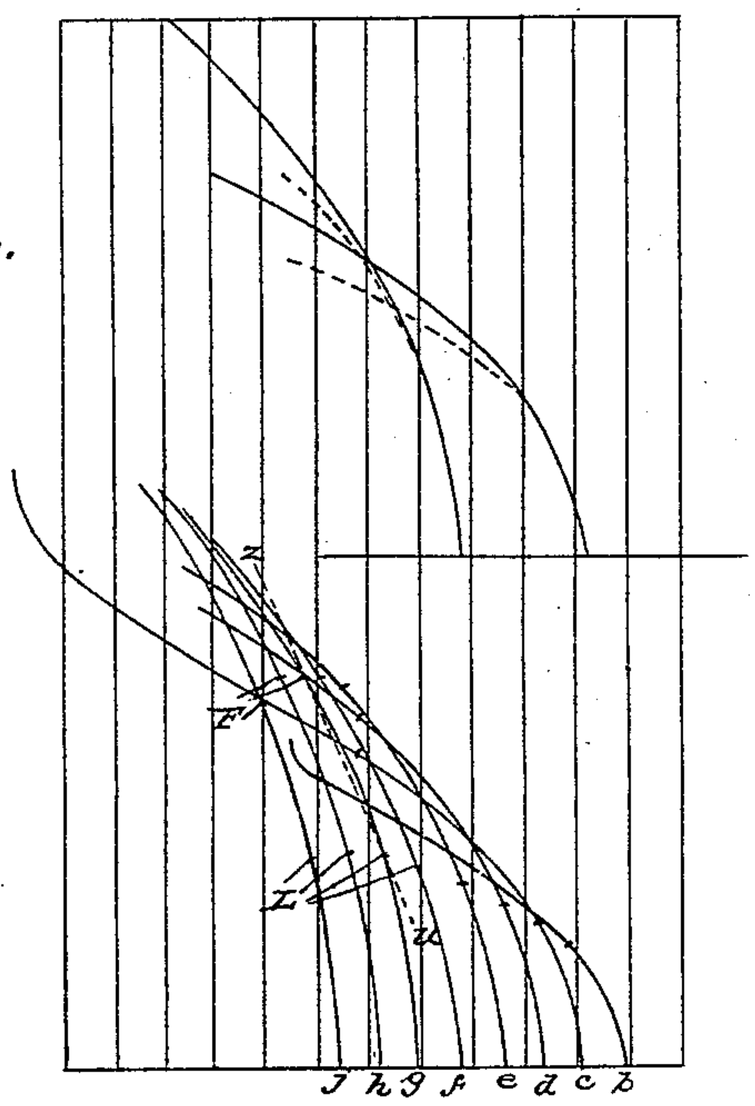
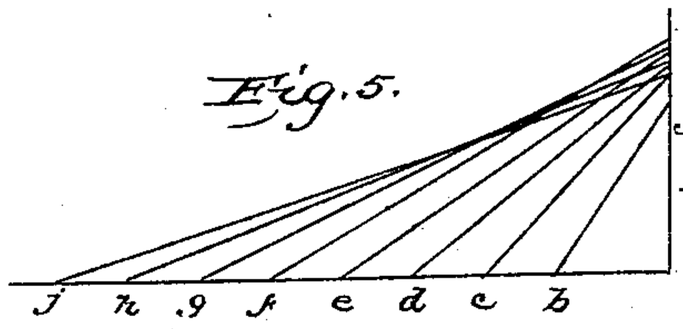


Fig. 5.



Attest,
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Wm. F. Hall

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(Model.) 2 Sheets—Sheet 2.

J. M. ADAM.

SCREW PROPELLER.

No. 602,651. Patented Apr. 19, 1898.

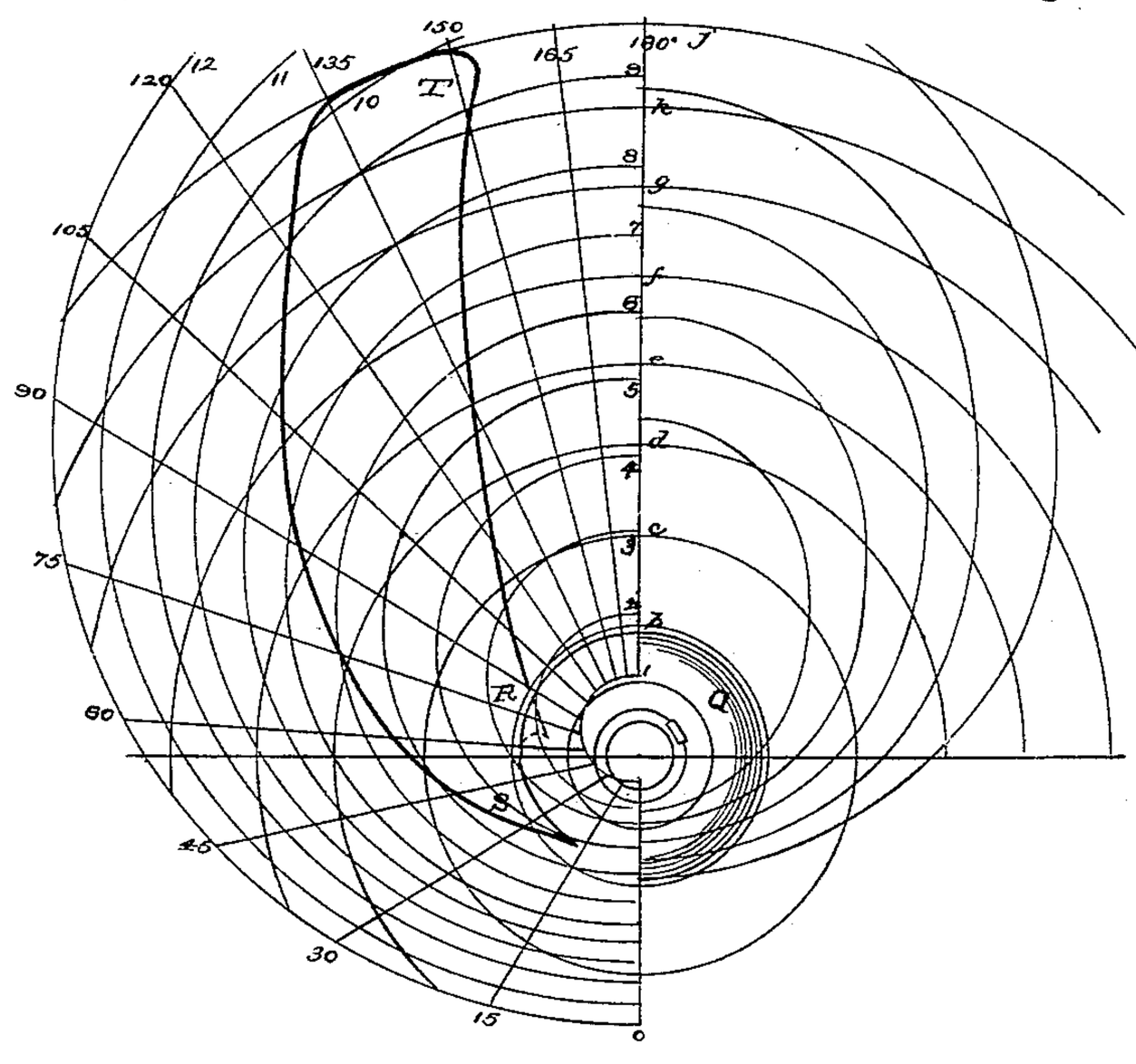


Fig. 2.

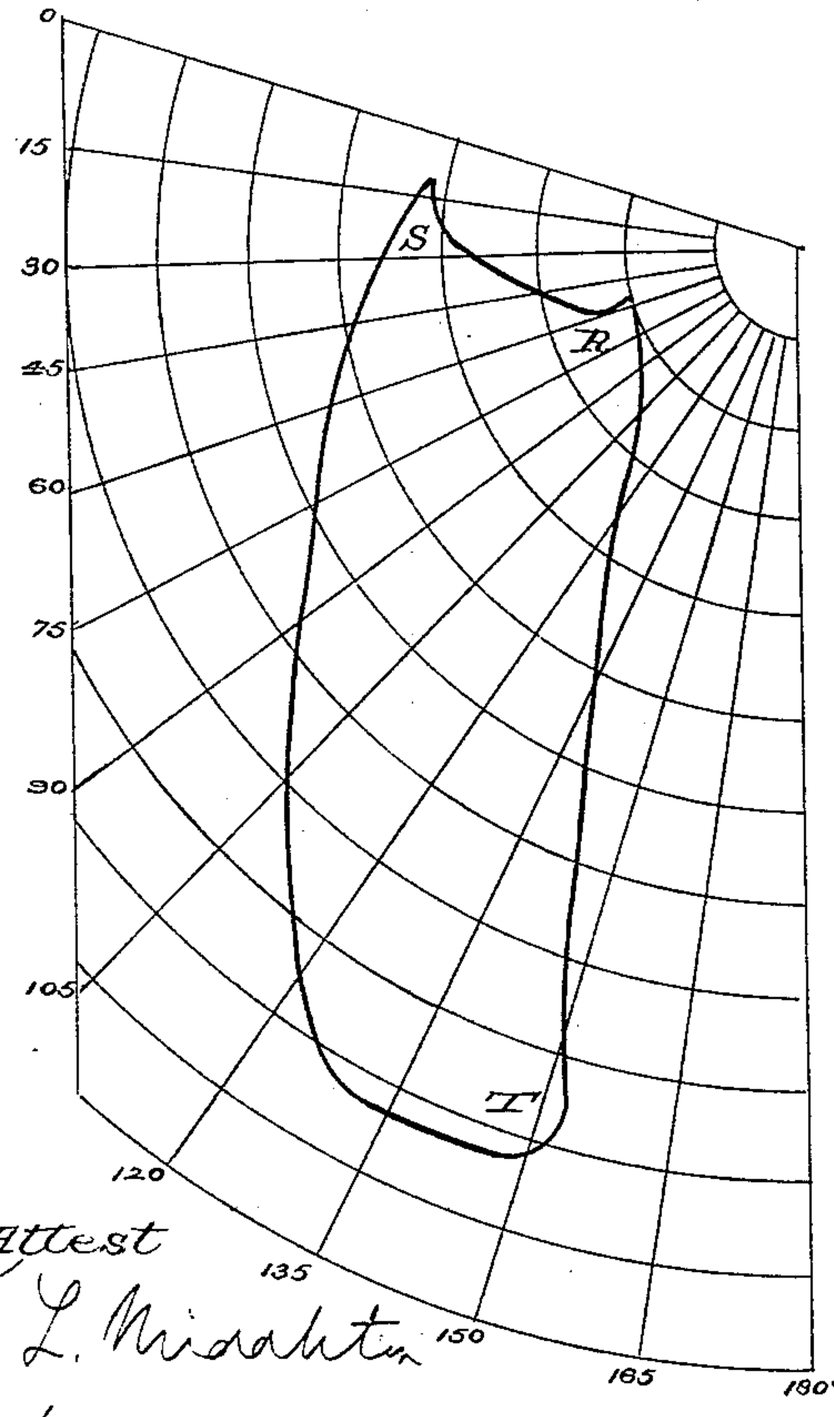
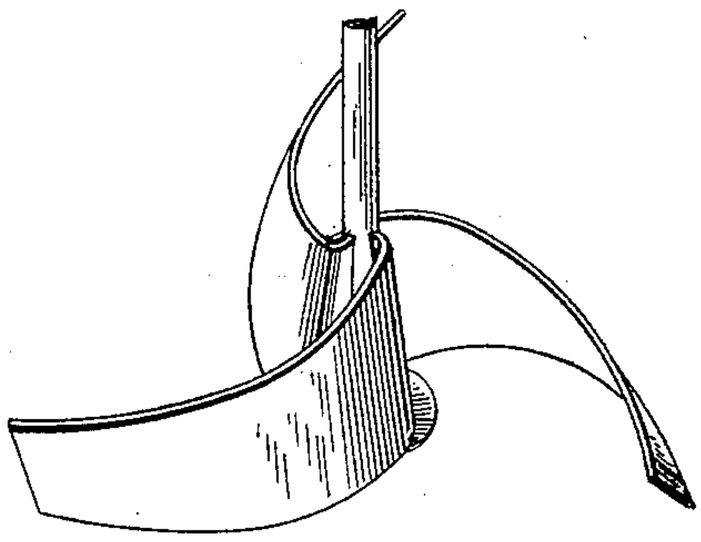


Fig. 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

JAMES MILLEN ADAM, OF GLASGOW, SCOTLAND.

SCREW-PROPELLER.

SPECIFICATION forming part of Letters Patent No. 602,651, dated April 19, 1898.

Application filed September 15, 1896. Serial No. 605,909. (Model.)

To all whom it may concern:

Be it known that I, JAMES MILLEN ADAM, a subject of the Queen of Great Britain, residing at Glasgow, Scotland, have invented certain new and useful Improvements in Propeller-Blades, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to vanes or blades applicable to air-impellers and fans, windmills, anemometers, ship-propellers, turbines, current or speed indicators, and to similar apparatus designed for transmitting motion to or receiving rotary motion from fluids by reaction.

In investigating the nature of revolving vanes or blades transmitting motion to fluids by reaction perpendicular to the plane of gyration I discovered that segments of the cone in certain positions seemed to offer theoretically perfect forms for such vanes or blades, owing to the cyclic character of the figure giving low tangential angles down to zero, whereby a fluid at rest may be entered or a current deflected without shock. If a hollow cone be passed over an axis or shaft and fixed by one of its sides longitudinally to the said shaft or to a boss thereon and the shaft be made to revolve, carrying the cone with it, one side of the cone presents a surface upon which may be plotted the outline of a vane or blade constructed on the principle of this invention. The axis of a cone so fixed is inclined to the axis of gyration, hereinafter called the "shaft-axis." This inclination of the cone produces the reactive quality in the vane or blade. The greater the inclination as the perigee edge approaches the shaft-axis the more pronounced will be the reactive surface, or, in other words, the greater will be the potential pitch ratio. The required vane will be contained in one side or half-cone as divided by the plane of inclination. The pitch-lines of a rotating half-cone correspond to the figure of cylinders concentric to its shaft-axis intersecting the cone-surface and are found to be symmetrical curves of increasing pitch from zero at apogee toward a point near to perigee, where the curve gradually reverses to a decreasing pitch reverting to zero. Every pitch-line is necessarily identical in form, differing only in scale of magnitude, and all contiguous lines produced by the same movement being identical in direction currents similarly produced will be homogeneous. It is demonstrable that the theoretical pitch-lines above described offer the path of least resistance to a fluid acted upon by the half-cone rotating with the apogee as leading edge, the reaction being rather centripetal and counteractive of centrifugal motion in the fluid. The generating-angle of the cone employed will modify the longitudinal inclination of the vanes or blades to the shaft.

In proceeding to construct vanes or blades on the principle above indicated a cone of the generating-angle and the inclination determined upon is drawn down to scale.

In the accompanying drawings I have shown how a vane or blade constructed according to my invention may be produced, and, by way of example, have illustrated with a cone having a generating-angle of seventy-five degrees, the apex of which is upon the shaft-axis and the perigee edge inclined fifteen degrees therefrom.

In the drawings, Figure 1 is a side elevation of a cone. Fig. 2 is an end elevation of the same. Fig. 3 is a diagrammatic view. Fig. 4 is a view of a portion of the surface of a cone. Fig. 5 is a detail diagrammatic view. Fig. 6 is a perspective view of a propeller, showing the improved blades.

Referring to Fig. 1, which shows in side elevation a cone A M P, A O is the axis of the cone, and A N the shaft-axis. Generating-lines are shown spaced fifteen degrees and numbered from perigee to apogee 0° to 180°. The cone is further divided by twelve circular planes from apex to base (marked 1, 2, to 12) and by twelve equidistant planes of gyration cutting ellipses through it. (Not shown in Fig. 1.) Fig. 2 shows the same in end elevation, and on left-hand side the above-mentioned generators 0° to 180° and the circular planes 1 to 12 are described. On the right-hand side in reverse are shown certain of the ellipses. Passing through these circular planes and ellipses are drawn eight circular arcs concentric to the shaft-axis, representing pitch-lines or cylindrical intersection or stream-lines, all as before described. These

circular arcs are lettered *b* to *j*, and are plotted with similar reference-letters across the surface of Fig. 1.

Fig. 3 shows in diagram the curves representing the above-mentioned cylindrical intersections unrolled or developed and showing the true pitch-curves across the conic surface upon the lines *b* to *j*, respectively. Upon each of these curves two points are marked off, L representing the leading edge, and F representing the following edge, of a blade suitable for a ship-propeller. A nominal mean pitch may be struck by a chord drawn from L to F, as is shown by the chord *z u*, drawn through the points L and F of the curve *g*.

It is obvious that the pitch of any point may be easily found by a tangential line produced, as above illustrated, in conic form. With a scale-pitch diagram, as shown in Fig. 5, any desired pitch may be fixed with precision, and any width of blade determined to suit the purpose required.

Reverting to Figs. 1 and 2, the side and end elevations of a propeller-blade R S T, corresponding to the pitch-lines found on Fig. 3, are superimposed upon the conic figures, showing also a suitable boss Q.

Fig. 3 shows the development of the conic surface and the vane or blade R S T plotted thereon. In proceeding to manufacture vanes so designed, constructed of sheet or rolled plates, the metal must be cut to the required form and may then be curved upon a rigid cone in the true position determined.

Foundry-work need not differ much from ordinary practice. To mold a ship's propeller in loam, the mold may be swept up by a rod guided over the corresponding surface of a small cone fixed in position at the apex and shifted round into position for each blade.

Where patterns must be used, these may be accurately formed by cutting a thin metal plate or plates to the proper shape for one or both faces, curving the same upon a rigid cone, and using it or them for facing and filling up thereupon the required thickness with any suitable material.

I claim—

1. A vane or propeller-blade having its body curved to conform to the surface of a conic figure attached to the hub about its perigee edge, said blade extending outward from the hub nearly parallel to the apogee edge of the figure according to pitch ratios determined substantially as set forth.

2. In combination the hub and blades carried thereby, said blades being each shaped to conform laterally to a conic surface which is inclined to the axis of its gyration and superficially to the outlines defined by the required pitch ratios determined substantially as described.

3. In combination the hub and the blade carried thereby, said blade being shaped to conform to the surface of a cone whose axis is inclined to the axis of rotation, and whose apex coincides with or touches the axis of said hub, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES MILLEN ADAM.

Witnesses:
ALEX B. FERGUS,
DAVID BLACKSTOCK.