(Model.) 2 Sheets—Sheet 1.

J. T. MARSH & T. S. TRUSS.

PROPELLER.

No. 450,417. Patented Apr. 14, 1891.

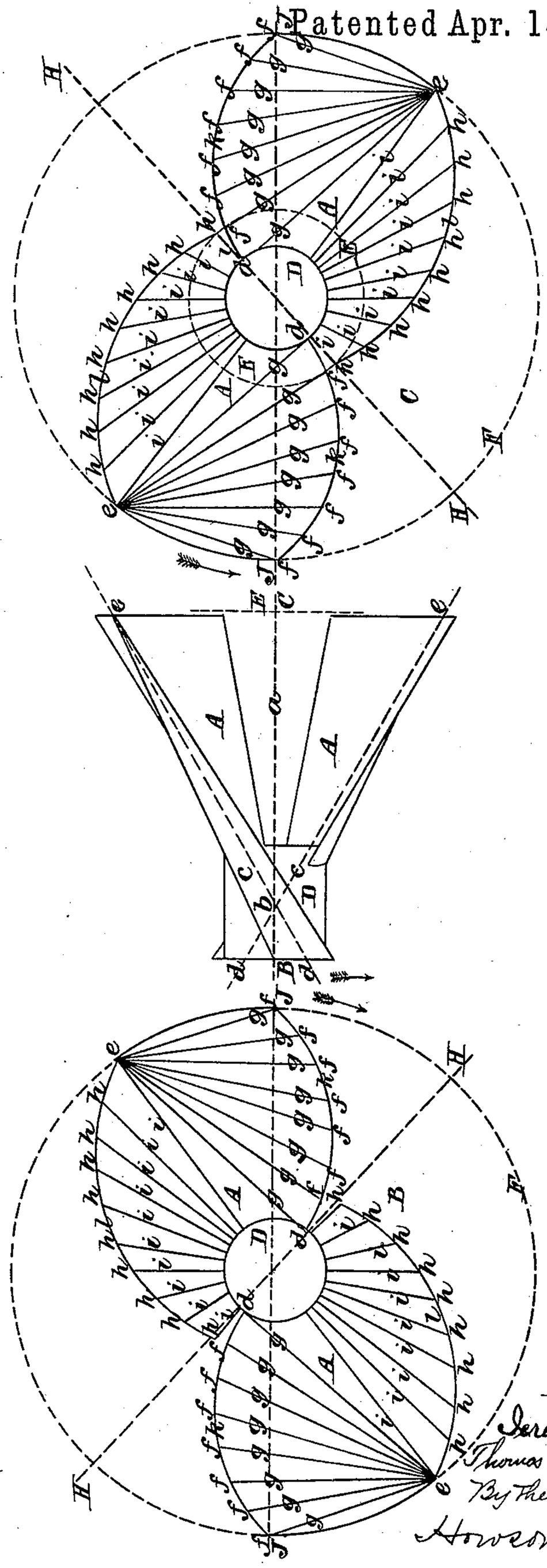

FIG. 3.

FIG. 1.

FIG. 2.

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(Model.) 2 Sheets—Sheet 2.

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Fig. 4.

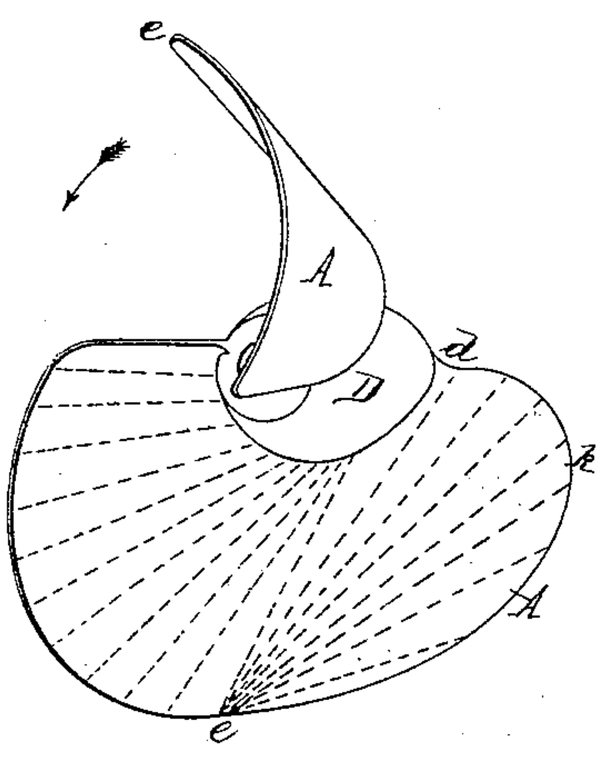


Fig. 5.

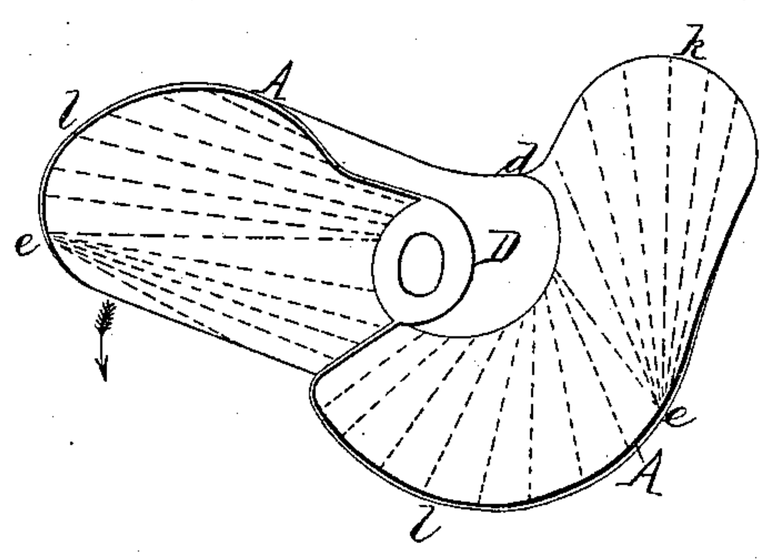


Fig. 6.

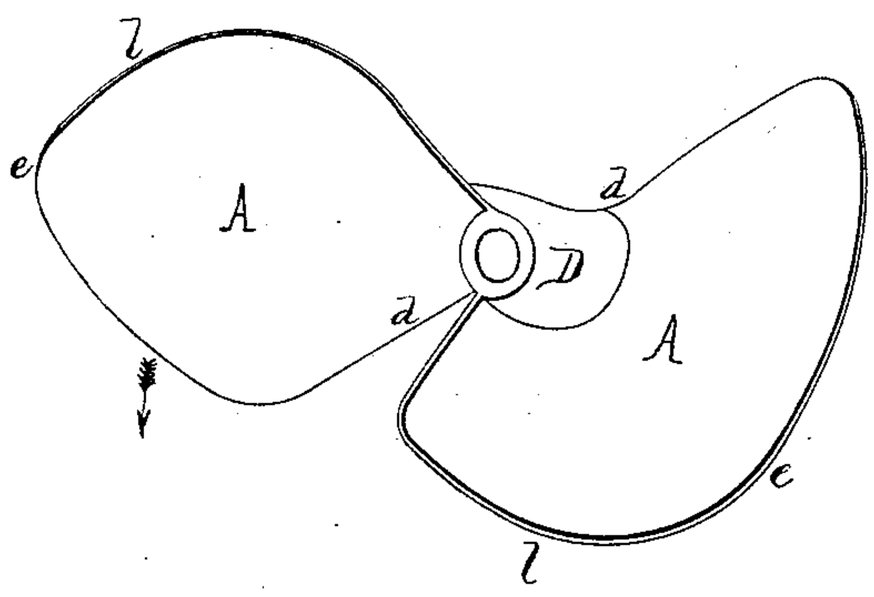
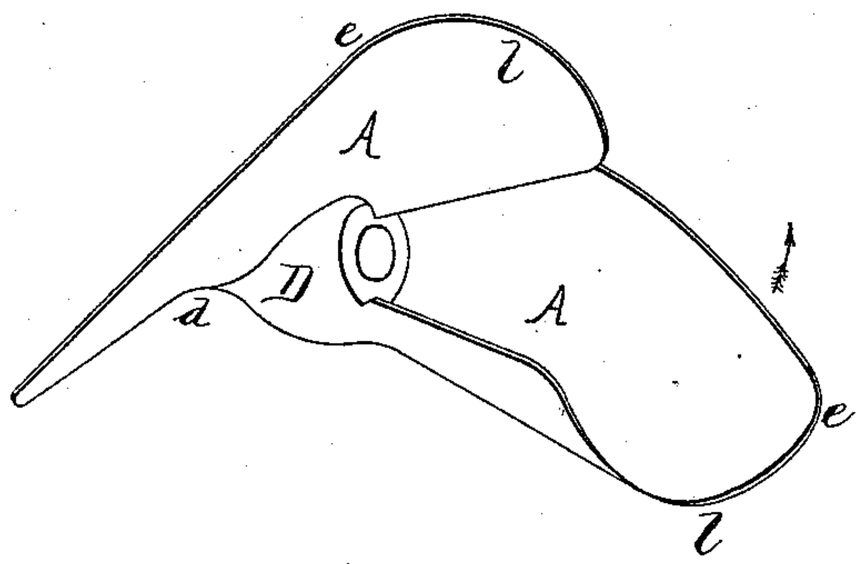


Fig. 7.



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UNITED STATES PATENT OFFICE.

JEREMY TAYLOR MARSH AND THOMAS SEAVILLE TRUSS, OF LONDON, ENGLAND.

PROPELLER.

SPECIFICATION forming part of Letters Patent No. 450,417, dated April 14, 1891.

Application filed August 6, 1890. Serial No. 361,192. (Model.) Patented in England February 13, 1890, No. 2,382.

To all whom it may concern:

Be it known that we, JEREMY TAYLOR MARSH, lieutenant-colonel royal engineers, and THOMAS SEAVILLE TRUSS, professor of natural philosophy, subjects of the Queen of Great Britain and Ireland, and residing, respectively, at No. 1 Pembroke Road, Kensington, in the county of Middlesex, England, and at No. 10 Chestnut Villas, Forest Gate, in the county of Essex, England, have invented certain Improvements in Rotary Propellers for the Propulsion of Vessels, also applicable for producing currents of air for all purposes, (for which we have applied for a patent in Great Britain, No. 2,382, dated February 13, 1890,) of which the following is a specification.

These improvements consist in the construction of "rotary propellers" to effect the propulsion of ships and other vessels floating on or immersed in water, the said propellers being also applicable for producing currents of air for all purposes.

These propellers are preferably constructed to have a length equal to about two-thirds of the measurement of their diameters, although they may have any other suitable proportions. One end thereof (which is in the ordinary position of the propeller the front end) we name the "penetrant end," and the other end we name the "run end."

These propellers have two or more blades, each arranged on a boss or driving-shaft and attached thereto at a given part of such blade. The point where the penetrant end of the blade joins the boss or driving-shaft we call the "penetrant point of the blade," and the point of the run end of the blade most remote from the shaft we call the "blade point of delivery." We take a point upon the axis of the shaft distant from the penetrant end of the blade about one-ninth of the diameter of the propeller measured in a direction toward the run end of the blade, and we term that the "intersection center." To determine the position of the blade and the blade point of delivery we draw a line through the intersection center, preferably at an angle of thirty degrees to the axis; but this angle may be varied, if desired, between wide limits—say from twenty to seventy degrees, though it will usually be better to make it thirty degrees, or thereabout. The blade point of delivery will be situated on this line, which we term the "angle-line for position," and this line also divides the part of the blade contiguous to the penetrant end from the part contiguous to the run end of the blade. There is of course an angle-line for position for each blade of a propeller, the angle which the line makes with the axis being the same for each blade, and the planes through the axis and the several angle-lines for position being situated at equal angular distances around the axis. A distance is set off along this line from the intersection center to give the position of the blade point of delivery, which is situated thereon, and the distance along that line from the blade point of delivery to the point where the line cuts the penetrant end of the propeller is called the "length for each blade." To obtain the form of the penetrant end of the blade we describe a curve, (which may be a segment of a circle, or a curve in either direction whose curvature increases as it proceeds in a direction away from the axis, or the contrary, or even a straight line,) which starts from the axis and is in a plane perpendicular to the axis, passing through the penetrant point of the blade. We prefer to curve such line so that the line drawn from the axis in the plane aforesaid to the extremity of the curve, makes an angle of about twenty degrees, with the tangent at the other end—*i. e.*, so that the curve lies between two planes through the axis inclined at an angle of about ten degrees to the plane bisecting the angle between them; but this angle may be varied considerably, if desired, from zero up to sixty degrees. If it be zero, the penetrant end becomes a straight line. We have described the penetrant end of the blade as lying in a plane perpendicular to the axis; but in practice we round the edge thereof somewhat (mainly at or near its extremities) toward the longer part of the angle line of position—*i. e.*, toward the run end. The extremity lies on or near a straight line parallel to the axis through the blade point of delivery, and the line joining it to the blade point of delivery forms the longitudinal edge

of the blade. Each of the blades has a peculiar curvilinear form, (except when the penetrant end is wholly in one plane through the axis, when part of the blade is flat.) The shape of the portion which depends on the penetrant end is obtained as follows: The form of line for this penetrant end of the blade being selected, its entire length is divided into short equal distances, and from these dividing-points lines are drawn to the blade point of delivery, and these lines give the form of the part of the face of the blade, which depends on the form of the penetrant end, which lines we name "the contiguous ous form lines." The form of the end of each blade at the run end of the propeller may be the segment of a circle, or a curve of decreasing or increasing curvature from the blade point of delivery on such run end of the blade to a point on a circle within the distance from the axis of about one-third of the diameter of the propeller, which we name the "boundary-circle." It lies substantially in a plane perpendicular to the axis; but both extremities at their edges may be rounded off a little forward toward the penetrant end. When the penetrant end is in front in line of motion, the curvature of the face of the run end of the blade has its concavity facing in the direction of the rotation of the propeller, and the penetrant end (if not flat) usually has its convexity turned in the aforesaid direction. It may however be made with its concavity in the aforesaid direction, as above explained; but in such case the concavity should be slight, and this arrangement is applicable to high-speed engines. The form of the line for the run end of the blade being selected, its entire length is divided into short equal distances, and from these points lines are drawn converging to the intersection center, or to a point thereabout, and these lines give the form in such run end for this part of the face of the blade.

When the propellers consist of two blades, each of the blades, from their point of commencement at the penetrant end to their ends at the boundary-circle, are so arranged that such points of each blade shall commence and terminate within a semi-circumference of the cylinder described by the propeller, or thereabout, and when such propellers consist of three or more blades, each of such blades commences and terminates in a proportionate sector of such cylinder. The sides of the blades that press on the water or air or other fluid when it is revolving with the penetrant end entering we call the "faces of the blades," and the other sides thereof we call the "back of the blades." The blades may have a uniform thickness, or the blades may have a thickness increasing from their outer edges to or toward the shaft or boss, (for additional strength.) The directions we have given are for the construction of the forms of the faces of the blades.

We have described the run ends of the blades of the propellers as terminating on a boundary-circle; but they may be continued toward the axis of the propellers until they join each other, and we have described the intersection center of the propellers as at a distance from the penetrant end equal to about one-ninth of the diameter of the propeller; but such intersection center may be on the longitudinal center line in line with the penetrant end thereof, or at other positions thereabout.

When such propellers are to be rotated to high velocity, then, in order to avoid vibration, that portion of the penetrant ends of the blades from their penetrant points on the boss or driving-shaft to a point on the edge of each blade equal to about one-sixth of their length longitudinally, measured from such penetrant ends may be cut off to the line of a circle or increasing or decreasing curve.

By our invention rotary propellers can be constructed for the propulsion of ships and other vessels floating on or immersed in water, which propellers give the greatest possible displacement of the water for their diameter, and concentrate or direct such displaced water passing through or by them toward the axial line of the propellers.

When propellers constructed according to our invention are applied for the propulsion of ships and other vessels floating on or immersed in water they may be situated and rotated in the well-known manner adopted for other rotary propellers. When such propellers are applied for producing currents of air, they may be used for the purpose of injecting or ejecting air, and for this purpose may be rotated in tubes or in any other convenient chamber for such purposes.

In order that the nature of our said improvements and in what manner the same are to be performed may be more fully understood, we will proceed to describe the several figures on the sheet of drawings hereunto annexed, in all of which figures like letters of reference are used to denote similar parts.

Figure 1 is a longitudinal or side view of a propeller constructed with two blades A A, attached to a boss, the said blades being formed according to our invention. Fig. 2 is the penetrant end view, B, Fig. 1, the form of line selected for this penetrant end being a curve decreasing in curvature from the penetrant point of blade toward the diameter of the propeller; and Fig. 3 is the run end view, C, Fig. 1, the form of line selected for this run end being a curve decreasing in curvature from the blade point of delivery to the circle E. Figs. 4 and 5 are perspective views of a propeller with the penetrant ends of the blades curved, and Figs. 6 and 7 are perspective views of a propeller with the penetrant ends of the blades flat.

The dotted line *a*, Fig. 1, is the longitudinal center line of the propeller, and *b* is the

intersection center thereon, and the dotted lines *c c* are the "angle lines for position" of the blades.

d d are the penetrant points of the blades A A, and *e e* are the blade points of delivery.

D is the boss or driving-shaft, to which the blades are attached.

The dotted circle E is the boundary circle at the run end of the propeller, the diameter of which circle determines the breadth of the blades at such ends.

The dotted circle F is the circumferential line, indicating the diameter of the propeller.

The letters *f f* indicate the dividing-points on the lines *k k* of the penetrant end of each of the blades, and the lines *g g* are the contiguous form lines for the face of the blades drawn radially from the centers *e* to the points on the lines *k*.

h h are the dividing points on the lines *l l* for the run ends of each of the blades, and the lines *i i* are the contiguous form lines for the face of the blades, drawn radially from the intersection point *b* to the dividing points *k* on the lines *l*.

The dotted line H is the diametrical line, on either side of which the propeller-blades are situated, and the dotted line J is a line showing the angle of degree from the diametrical line H, at which the blades terminate on the circle F at the penetrant end of the propeller.

The propeller should be fitted to the shaft, so that the end B is next the ship, and when the propeller is rotated in the direction of the arrows the ship moves forward, while when it is rotated in the opposite direction the ship moves astern. It therefore follows that, if desired, the propeller may be mounted in the reverse position.

We have illustrated what we consider the best form for a propeller constructed according to our invention; but we do not restrict ourselves to the precise forms or proportions illustrated. The blades may be attached to the driving-shaft or boss in any suitable way—such, for instance, as by making the blade solid therewith, or by attaching them to the boss or driving-shaft on a center pin at or about a point coincident with the intersection center—so that the angle for position of blade may be adjusted as desired, and the blades be fixed in their adjusted position.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is—

A rotary propeller for propelling ships and other vessels floating on or immersed in water and for creating air-currents for all purposes, the said propeller being formed with two or more blades attached at an angle to a boss or driving-shaft, the form for the face of such blades contiguous to the penetrant end thereof being produced by lines drawn from the blade point of delivery to dividing-points on the line selected for the penetrant end thereof, and the form for the face of the part of such blades contiguous to the run end thereof being produced by lines drawn from the intersection center to dividing-points on the line selected for the run end of such blades, substantially as hereinbefore described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

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