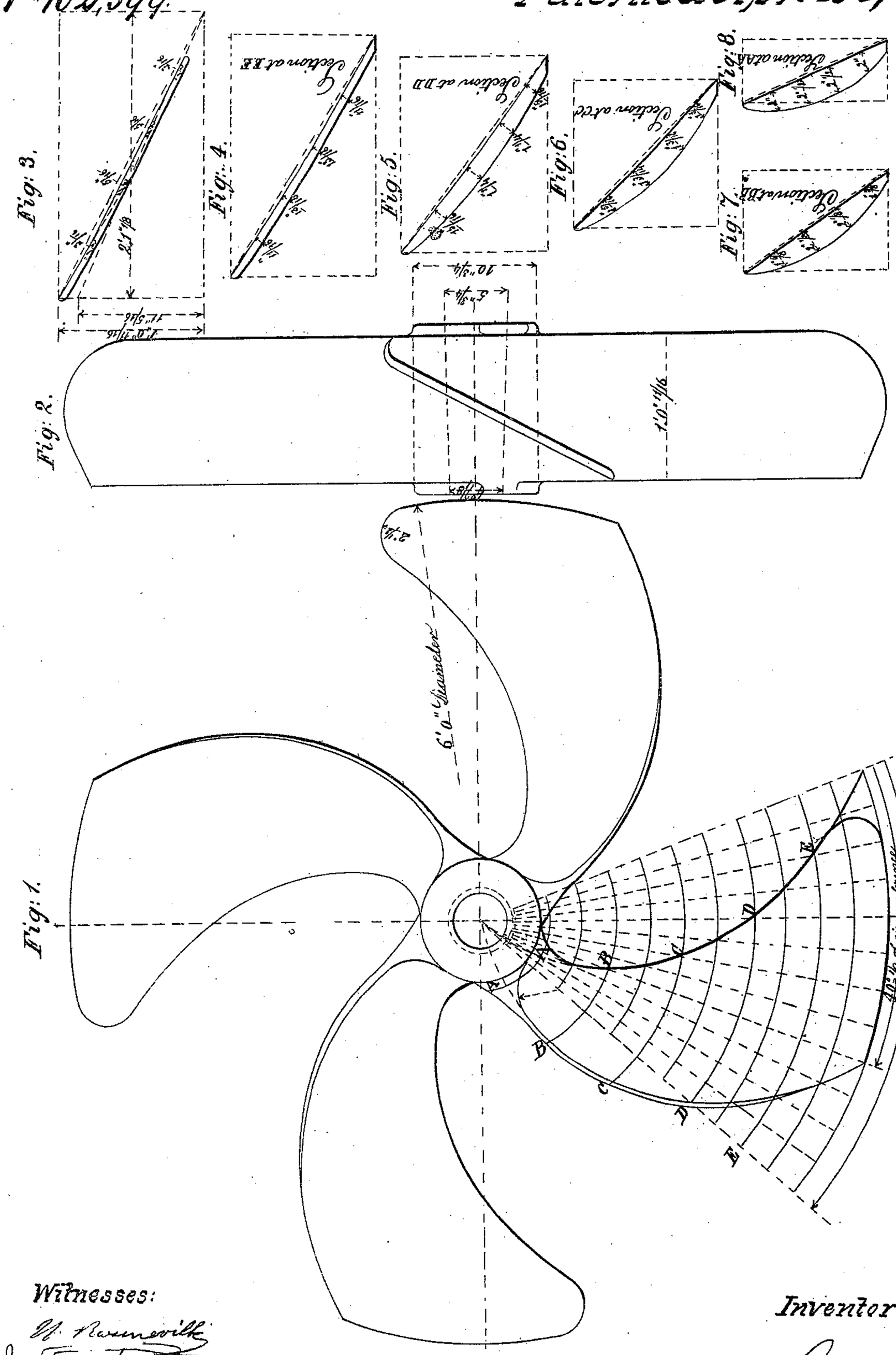
H. Hirsch.

Screw Propeller.

No. 102,399. Patented Apr. 26, 1870.



Witnesses:

W. Ravenscroft

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HERMANN HIRSCH, OF PARIS, FRANCE.

Letters Patent No. 102,399, *dated April* 26, 1870; *patented in France December* 16, 1865.

IMPROVEMENT IN SCREW-PROPELLERS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, HERMANN HIRSCH, of 24 Rue du Mont Thabor, Paris, in the Empire of France, civil engineer, have invented certain new and useful "Improvements in Screw-Propellers;" and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings forming a part of this specification, in which—

Figure 1 is a front elevation, and

Figure 2 an end elevation of my improved propeller, and

Figures 3, 4, 5, 6, 7, and 8, sections of one of the blades, made at different distances from its axis.

My new or improved propeller embodies the essential principles of a screw, with such a modification of form in the transversal and longitudinal curvature of the blades as secures certain advantages and avoids certain evils.

The object of a propeller being to convert the rotatory motion of its surface, into a pressure directed in the line of its axis, that is the best propeller which converts a given rotatory power into the greatest longitudinal pressure, or which produces a given longitudinal pressure from the least rotatory power consistently with facility of steerage and absence of vibration.

The extent to which these objects are attained by my propeller may be best understood by comparing it with an ordinary straight-bladed screw, the form of propeller found best until now, although various modifications have been devised with intent to accomplish the object of my improvement.

In practice, the pitch of the propelling-screw is made somewhat greater than that which theoretically is adequate to produce the speed of the vessel; that is to say, the surface of the blades is at every point somewhat more inclined to the axis, than the line which would at that point represent the resultant of the rotatory velocity of the surface, and its forward motion through the water. This excess of "pitch," commonly called "slip," is essential, because it represents the yielding of the fluid medium in which the screw acts, the inertia of the fluid, or its resistance to this yielding, being, in fact, a measure of the propelling force. When all this force is applied at once, as in the common screw, and in all other propellers where the inclination of the blade is the same across its whole breadth or face, not only is the resistance to rotation greater, but the water, being suddenly put in motion backward at the very front edge, is scarcely acted on by the rest of the blade, which becomes comparatively useless, more especially as the water, suddenly put in motion at the front edge, becomes much broken, and less capable of reacting on the remaining portion of the breadth.

In my "improved propeller," the front or entering-wedge is so inclined to the axis that it cuts the unbroken water with little or no resistance, and the rest of the blade gently curves backward, being more and more inclined, so as to give the water a gradually-increasing backward motion, thus not only avoiding the excessive resistance caused by a sudden impulse on the water, but also maintaining a uniform reactive pressure from unbroken water over the whole breadth of the revolving blade. This advantage may be appreciated by those who know how valuable for avoiding resistance are the hollow lines in the run of a fast-going vessel. Indeed, when it is borne in mind that all the force expended in driving a screw round its axis is useless in propelling, except in so far as that force by angle of surface becomes resolved into force directed in the line of the axis, it is obvious that hollow lines in the curvature of the blades, as in my improved screw-propeller, are essential, in order to cause the least possible resistance to rotation consistently with the required force of propulsion.

Again, the ordinary screw acts like a fan, not only driving the water backward, but also throwing it, by centrifugal force, outward from the axis, and, in the oblique action resulting from these two motions, it not only loses much of its effect in propelling the vessel directly forward, but, by breaking the back-water and causing a great divergence and eddying in its streams, it deprives the rudder of much of its steering-power. In my "improved screw-propeller" the blades are curved inward so as to dominate the centrifugal force, and to use it as an auxiliary to drive the water in an unbroken column directly astern. The reaction of the water is thus entirely expended in direct forward propulsion, and the influence of the rudder, surrounded and acted on by the unbroken and fast-moving fluid, is at once more quick and certain.

And further, while one blade of an ordinary screw is moving along the upper arc of its course, it displaces the water with ease; but, the other blade, moving at the same time in deep water, encounters great resistance, which tends to lift the vessel and jerk it to one side. This action being repeated twice in every revolution of the screw, puts the vessel into a state of vibration which renders it impossible to work many screw-steamers at full speed, and even at moderate speed loosens and endangers the stern framing. In my screw-propeller the blades, owing to their curvatures, have their surfaces brought gradually into action with every fresh volume of water in all parts of their revolution, and their action on the water is thus divided and delivered easily and gradually without vibration, and with proportionally less expenditure of power. My improved propeller will thus produce very superior results, whether an equal speed, with a saving

of fuel shall be required, or, with an equal expenditure of fuel, a higher speed; in either case accompanied by the two other advantages of absence of vibration and increase of steering-power.

After this general explanation, which sufficiently describes the innovation for which I solicit a patent, it is necessary, for greater clearness, to enter into some developments relative to the accompanying drawing.

Figs. 1 and 2 of the annexed drawings represent, on the scale of one and one-half inch to a foot, a four-bladed screw-propeller on my improved principle. The two extreme lines and the whole of the intermediary lines of the surface are spirals, comprised in an angle of sixty degrees, thus generating from the axis to the circumference a hollow, curved, or spoon-shaped form of blade.

The points of the spirals may be rounded off without inconvenience, and their curvatures may be modified toward the axis to give greater strength. This latter practical modification made near the center, where the propelling surface is of small effect, does not diminish the advantage of the propeller. The projected surface of each blade is one-ninth of the whole disk, which corresponds to an angle of forty degrees measured on its circumference.

The helicoïdal directing-line or directrix of increasing pitch is determined by the development of the different cylindrical sections, made from the center to the circumference, and represented in figs. 3, 4, 5, 6, 7, and 8. These figures show the different thicknesses and modifications required for the strength of the whole.

Up to the present time I have found that the spiral of sixty degrees, shown in the drawings, gives the best results, but as it is obvious that variations from this standard would only affect the utility of its operation in a degree, and that, depending to some extent upon the speed of rotation and the density of the water, as between inland and ocean navigation, therefore, I define my improvement as consisting in such curved generating lines for screw-propellers, as to produce blades of concave faces transversely, and enter into spirals of different degrees or angles, of which I prefer those comprised between forty-five and sixty degrees.

Lastly, it is almost superfluous to add that I do not intend to confine the application of my invention to propellers with four blades, to a projected surface of forty degrees, and to the degree of increasing "pitch" shown in the drawings, as the number of blades, the extent of surface, and the degree of increasing "pitch," may be varied according to circumstances.

Having now described the nature of my said invention of "improvements in screw-propellers," and the manner in which the same is to be performed, I would remark, in conclusion, that—

What I claim as my invention, and desire to secure by Letters Patent of the United States, is—

1. Constructing screw-propellers with blades, the faces of which are formed of concave lines in cross-section, in combination with an increasing pitch or helicoïdal inclination from the axis to the circumference, substantially as set forth.

2. In combination with said transverse curvature and graduated helical form, the recession of the forward terminal edges of the blades, substantially as and for the purposes set forth.

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Witnesses:

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(102)399