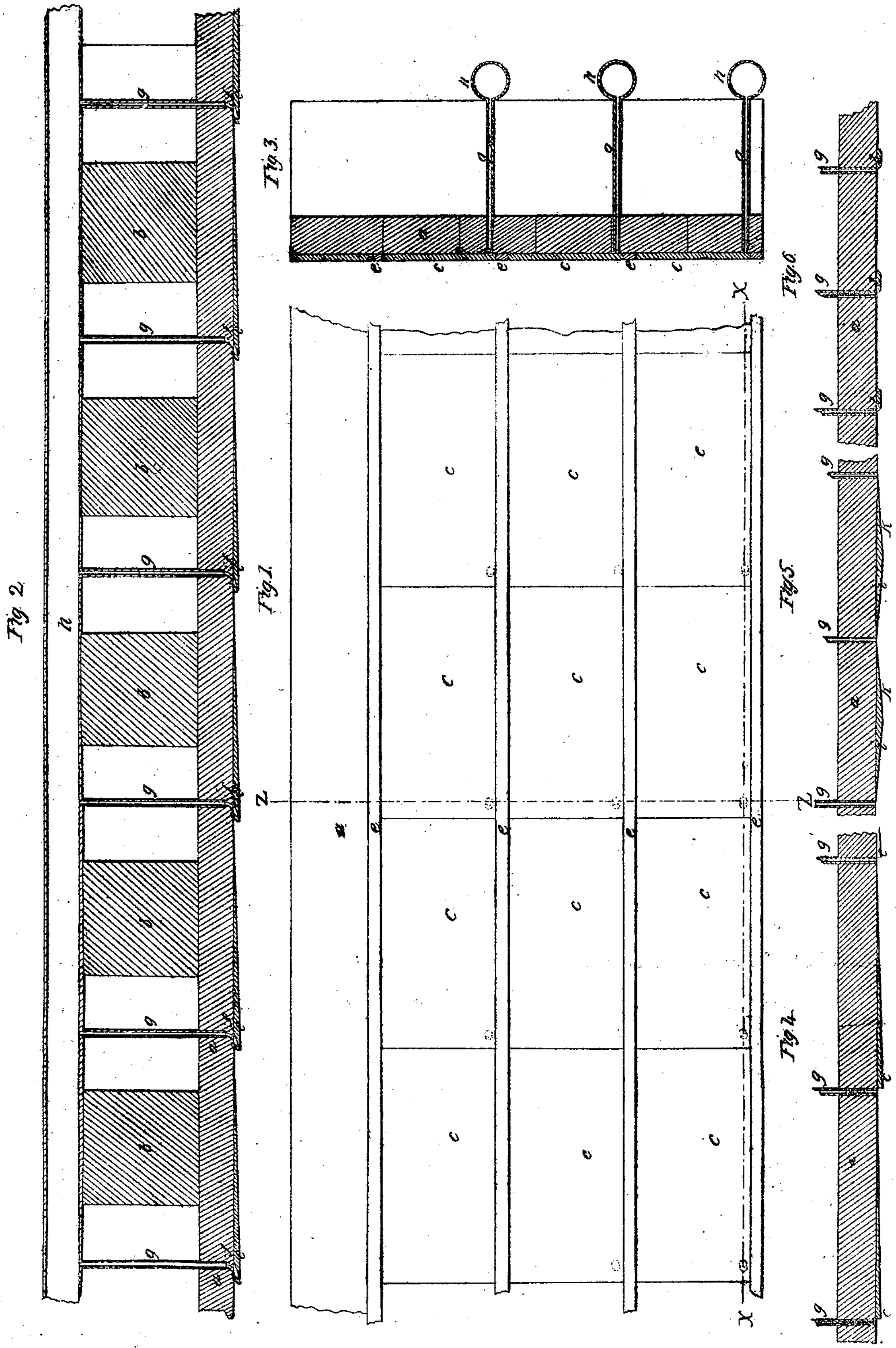
R. L. & F. B. Stevens.

Pneumatic Propeller.

№ 5644

Patented Jun. 20, 1848.



UNITED STATES PATENT OFFICE.

ROBERT L. STEVENS, OF NEW YORK, N. Y., AND FRANCIS B. STEVENS, OF HOBOKEN, NEW JERSEY.

IMPROVEMENT IN APPARATUS FOR THE INCREASE OF THE SPEED OF VESSELS.

Specification forming part of Letters Patent No. **5,644**, dated June 20, 1848.

To all whom it may concern:

Be it known that we, ROBERT L. STEVENS, of the city, county, and State of New York, and FRANCIS B. STEVENS, of Hoboken, in the county of Hudson, in the State of New Jersey, have invented certain Improvements in Applying Means and Apparatus to Vessels and Ships to Increase or Improve Their Speed; and we do hereby declare that the following is a full and exact description thereof.

It has long been known that the resistance that hinders or impedes the motion of vessels through the water arises from three causes—viz., the displacement of the water by the vessel, the "suction" (as it is termed) at the stern, produced by the motion of the vessel from the water, and, lastly, the friction produced by the immersed surface of the vessel passing through the water. We have not noticed the inertia of the mass to be propelled, as that when once overcome is no longer a resistance and the propelling machinery is always constructed with a view to act regularly and keep up the acquired momentum. It has also long been known that the resistance caused by the displacement, as also that caused by the suction, could be reduced by making the vessel sharper and of greater length in proportion to the breadth, so that the water as the vessel moves through it could be displaced by the bow more easily and fill up at the stern more gradually. The friction produced by the immersed surface of the vessel in passing through the water has frequently been looked upon as too trifling to be considered an element in calculating the resistance to the motion of vessels, and hence but few efforts have been made to reduce or modify a resistance generally supposed to be much less than it actually is. Although the experiments made in 1796, &c., by Colonel Beaufoy upon the subject of the resistance of fluids have been considered as the basis of all other investigations upon this subject, still his experiments upon the subject of friction have not generally attracted that attention which they deserve. The amount of the friction of water (against a surface of wood planed smooth and painted) for each square foot of surface immersed in the water and the general law of its increase at different velocities were given by him at velocities from two to ten miles per hour. These experiments on friction have been corroborated and continued by another series carefully conducted by us on the Delaware and Raritan Canal, in New Jersey, with various substances and qualities of surface and at speeds of from one mile per hour to upward of forty. By these experiments we have proved that the resistance due to friction increases as the squares of the velocities, and we have found that in the sharpest steamboats of the present day that which has been frequently deemed too inconsiderable to enter into a calculation is the largest element of resistance.

In vessels where the length is small in proportion to the breadth, and where the angles of the bow and stern are obtuse, the resistance caused by the friction of the water against the sides and bottom of the vessel is very small compared with the resistance caused by the displacement and the suction; but in vessels where the length is very great in proportion to the breadth, and where the angles of the bow and stern are exceedingly sharp, the resistance caused by the friction of the water is greater than the resistance caused by the displacement and the suction. We have found by actual experiment that in a vessel two hundred and twenty feet long, sixteen feet wide at the water-line, molded very round, or, as it is technically termed, "much cut up," drawing three feet of water, and the angle of the bow six degrees, more than three-quarters of the resistance to the motion of this vessel was due to the friction of its immersed surface passing through the water. The means commonly used to diminish this friction have been to render that part of the surface of the vessel as smooth and even as possible; but we have become satisfied by our experiments, made with various substances and on various surfaces, that even on the most highly-polished surfaces there is much friction, much more than is generally supposed. We have been particular in stating the existence of this friction, its magnitude, and the law of its increase, as it is the object of the principal part of our invention for improving the speed of vessels to diminish this friction, and this we do by the interposition of a stratum of atmospheric air between the immersed surface of the vessel and the water, which we find greatly reduces the resistance arising from this friction. The air is to be applied and supplied continuously to the bottom of the vessel while it is in motion, and over the whole or as large a portion of the immersed surface as possible, and to be introduced by bellows or other blowing apparatus through pipes, channel-ways, or other conductors leading to apertures made in the sides and bottoms of vessels, or by means of pipes or other conductors running over the sides and bows of vessels and terminating in apertures or orifices distributed over the immersed surface of vessels.

It has been a maxim among naval architects and constructors that to prevent as much as possible the friction of the immersed surface of vessels against the water, it (the surface of vessels) must be made smooth; but to interpose air between the surface of the vessel and the water with the view to reduce friction we depart from this maxim, and in departing from it we make over the entire immersed surface to be supplied with air certain irregularities, consisting of projections and recesses, which produce two useful effects—viz., first, they make the interposition of the air more perfect by distributing it equally over the entire surface and by retaining it more perfectly and for a longer time than could otherwise be done, and, second, they produce by a well-known physical law a suction in the apertures tending to supply the air, by which less pressure is required to supply the air to be interposed between the surface of the vessel and the water. The most effectual way of making the projections and recesses is to put them on in manner somewhat resembling the scales of a fish or the shingles on the roof of a house—that is, a series of inclined planes forming a slight angle with the plane of the vessel's surface, and arranged in the direction of the length of the vessel, so that the summit of all the planes will be toward the stern, that when in motion the water shall by the direction of the motion pass from the tip of one scale to the tip of the next succeeding one, the air on the inclined surface of the recesses formed by the series of the planes or scales having the effect to prevent the water from being forced by the pressure of the column into the recesses. The air will thus be sheltered in a measure in these recesses, and the vessel will be in contact with the water only at or near the tips of the scales, and will thus pass with a stratum of air interposed between its surface and the water, and therefore prevent that amount of friction which constitutes so large an element in the resistance to the motion of vessels.

The most effectual way of supplying air to the recesses is through apertures at the lowest part of each recess and conducted there from pipes, channel-ways, or other conductors by holes made in the vessel or by branch pipes passing through the holes, so that the air may issue at the deepest part of the recesses and pass along and spread over the entire surface of the planes; but it is not necessary, to produce a beneficial effect, that there should be an aperture in each recess for the supply of air, as the air supplied to one recess will be carried over the tips of the scales or planes and forced by the pressure of the water into and thus supply several recesses astern of it. We have found in a scow-shaped vessel, or in one where the sides are inclined outwardly, that in supplying the recesses with air at the bow and stern a large portion of those in the center need not be supplied and still a beneficial effect produced, as the air introduced in the recesses at the bow is carried from thence under the bottom of the vessel toward the stern and forced up by the surrounding water into the recesses not otherwise supplied. We would observe that when there is no air in the recesses we have always found these projections and recesses detrimental, causing more resistance to the motion of the vessel than a plane surface would do. The recesses formed between the summits of the series of planes should be divided into cells by longitudinal partitions to prevent the escape of the air at the sides. The use of projecting parts and recesses for the purpose above specified constitutes the second part of our invention.

The air applied as above described, besides reducing the friction, will have the effect to diminish the suction at the stern of the vessel. We have found by experiment that if apertures are made at the stern large in size and placed closely together and communicating with the atmosphere by tubes the pressure of the atmosphere through these tubes will diminish the suction of the vessel in its passage through the water. We place these apertures as closely together as possible without weakening too much the structure of the vessel or reducing too much the buoyancy at the stern. The tubes or conductors leading to the atmosphere must terminate at such distance from the water as may be deemed requisite to prevent the water from overflowing them. The use of these apertures at the stern to diminish the suction constitutes the third part of our invention.

We will now proceed to describe by reference to drawings how the surface of a vessel is to be constructed with the view to the application of our invention.

In the accompanying drawings, Figure 1 is a face view of a portion of the surface of a vessel on our improved plan; Fig. 2, a horizontal section taken at the line XX of Fig. 1, and Fig. 3 a vertical section taken at the line Z Z of the same figure.

On the ordinary planking *a* of a vessel constructed in any desired manner, which planking is here represented secured to the timbers *b*, are attached wedge-like projections *c*, the outer surfaces of which are inclined to the plane of the planking, with the summits of each inclined plane toward the stern of the vessel. These wedge-like projections, which we term the "scales," because of their resemblance to the scales of a fish, overlap one another, leaving a space *d* under the after part of each scale, and the spaces between the summits constitute the recesses named in the preceding part of this specification, and these recesses are further divided into cells by longitudinal partitions *e*, to prevent the escape of the air at the sides. Holes *f* are made in the planking of the vessel, to which pipes *g* are fitted leading to main pipes *h* or channelways or other main conductors for the supply of air, and the holes *f*, one or more for each cell, should be made under the projecting or after part of each scale, so that the air in issuing from these holes may diffuse itself and cover the entire surface of each cell. Instead of making the scales to overlap, their after ends may be perpendicular to the plane of the vessel, as shown in section, Fig. 4, or instead of this the recesses may be made of double and reversed inclined planes *i k*, as shown in section, Fig. 5, or the recesses may be formed between ribs *l l*, the edges of which may be rounded off, as shown in section, Fig. 6. In these various modifications the holes for the supply of air should be made in the most depressed part of the recesses.

At Fig. 1 will be seen the side elevation of an entire vessel with the scales applied. This is represented as being propelled by paddle-wheels; but other modes of propelling may be substituted, such as screws, sails, &c.

We have used the inclined planes of various dimensions and have found the proper inclination to be of more importance than the length. We have used them three inches long with an inclination of one in twenty-five, and eight feet long with an inclination of one in ninety, with a beneficial effect. These projections and recesses can be formed out of the solid material of the vessel or made separate and attached thereto. If it were judged inexpedient to make the apertures through the bottom of a vessel, tubes could be run over the sides and introduced in the intervals between the planking and the projections or scales, or the vessel may be built with two thicknesses of planking and the air introduced into an interval left between them, this space being separated into divisions by ribs running from the bow toward the stern.

The air, as above mentioned, can be applied to a vessel's bottom without the intervention of these projections; but, excepting at very low velocities and where the nature of the construction may render it necessary, we prefer the application of it by means of projections and recesses; but when applied without the recesses we should recommend that the apertures be covered with plates and the air made to issue from under the after part of these plates, or that a rib or scale be placed in front of the aperture or apertures to reduce the pressure required to force out the air. In respect to the quantity of air required, we have at the speed of fifteen miles per hour used one and a half cubic feet per minute for each square foot of the immersed surface of the vessel and have found it to produce a beneficial effect, and at a speed of twenty-eight miles per hour we have used five cubic feet of air per minute for each square foot with beneficial effect, the scales being sixteen inches long and having an inclination of one in sixty. We have given no directions as to the blowing apparatus by which the air must be supplied, as this would of course vary according to circumstances, the subject of forcing air under different pressures being well understood. Care must be taken that the air be delivered at different pressures to the orifices that are at different depths or perpendicular distances from the surface of the water, so that the greater portion of the air shall not escape from a few of the apertures.

In respect to the suction produced by the recesses, we would remark that at a speed of twelve miles per hour with scales one foot long, having an inclination of one in twenty-five, the water was all drawn out of a tube six inches deep, and this suction increased with the velocity, so that at a speed of twenty-four miles per hour the water was drawn out of a tube thirty inches deep, and we found that at a speed of thirty miles an hour sufficient air was drawn under the sides and bottom of a vessel drawing one foot of water to produce a beneficial effect without the intervention of blowing apparatus.

If it should be judged inadvisable from the want of sufficient power to force the air, or from other causes to supply the air, over the whole immersed surface of the vessel, the projections and recesses could be applied to a portion only of the surface. This method of diminishing the friction is applicable to all vessels; but it is more peculiarly adapted to vessels where the length is great in proportion to the breadth, where the angles of the bow and stern are sharp, and where the draft of water is light, so that a sufficient supply of air can be readily obtained.

By the method above described the friction of the water against the whole immersed surface and the suction at the stern is diminished, but the resistance caused by the displacement at the bow remains a fixed quantity, the way of reducing which is by giving the vessel greater length in proportion to the breadth and by reducing the angle of the bow. This angle we recommend to be as sharp as the construction of the vessel and the purposes for which it is intended will allow.

It will be obvious that if any of the permanently-elastic gases be substituted in whole or in part for atmospheric air the same effect will be produced.

We are aware that it has been proposed to surround the bottom of a vessel with ledges, making the bottom like an inverted box, and to introduce air, under a pressure, into this box for the purpose of raising it to decrease the draft of water; that air has also been forced under the water from a vessel to act as a propelling agent. We are also aware that a patent was granted in England in the year 1818 to Thomas Cochrane and Alexander Galloway which included among other matters the getting rid of the gases evolved from the combustion in the boiler-furnaces of a steamer, or, as they say, to allow such gases to escape for dissipation by blowing them under water, but without intention to diminish friction and without any description of means by which it could produce the effect; but

What we claim as our invention, and desire to secure by Letters Patent, is—

1. Applying air to the immersed surface of a vessel in motion, in manner substantially as described, and thus interpose (by a continuous or intermittent supply) a stratum of air between the immersed surface or portions thereof of the vessel and the water for the purpose of reducing the friction of the water, as described. We do not claim this application to propel the vessel, but to be used in connection and combination with paddle-wheels, screws, sails, or other propelling agent.

2. The recesses on the immersed surface of the vessel formed by the scales or other irregularities, as described, or anything substantially the same, when combined with the supplying of air, for the purpose of distributing the air and for retaining it more perfectly and for a longer time between the surface of the vessel and the water; but it is to be understood that we do not claim these recesses independently of their use and connection with the use of air to reduce friction.

3. The plates over the air-apertures or the scales or ribs in front, substantially as described, to reduce the pressure required for the discharge of the air; but this we claim only when air is used as a means of reducing friction.

4. The apertures made in the stern of a vessel, communicating with the atmosphere by pipes or other conductors, for the purpose of diminishing that resistance produced by the motion of the vessel from the water, commonly called the "suction" at the stern. We do not claim the use of these apertures, excepting in connection with paddle-wheels, screws, or other propelling agent.

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Witnesses:
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JOSEPH MAYNETTE.