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C. DEL LUNGO.

MEANS OF REDUCING THE RESISTANCE TO THE MOTION OF VESSELS THROUGH WATER.

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Fig. 1.

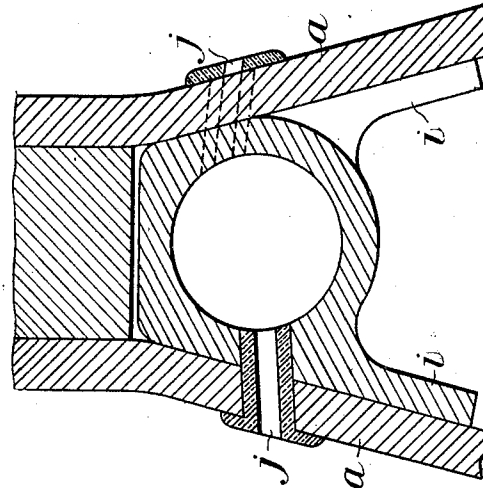
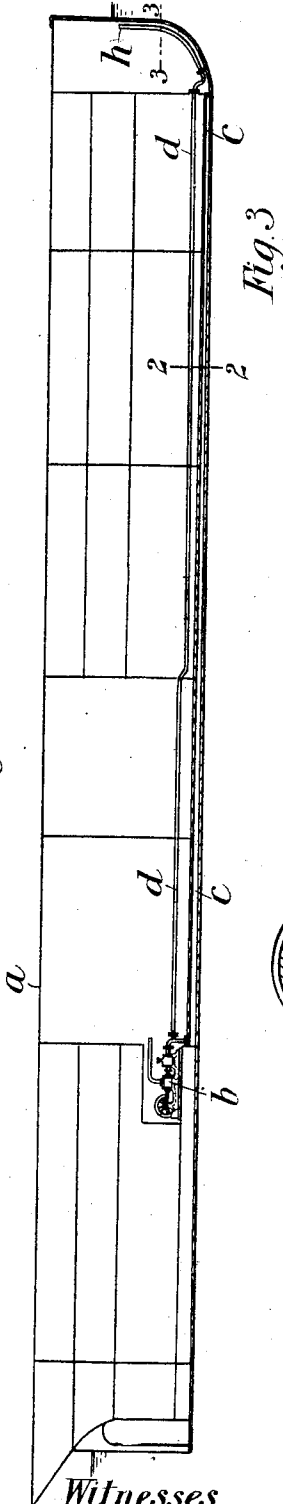
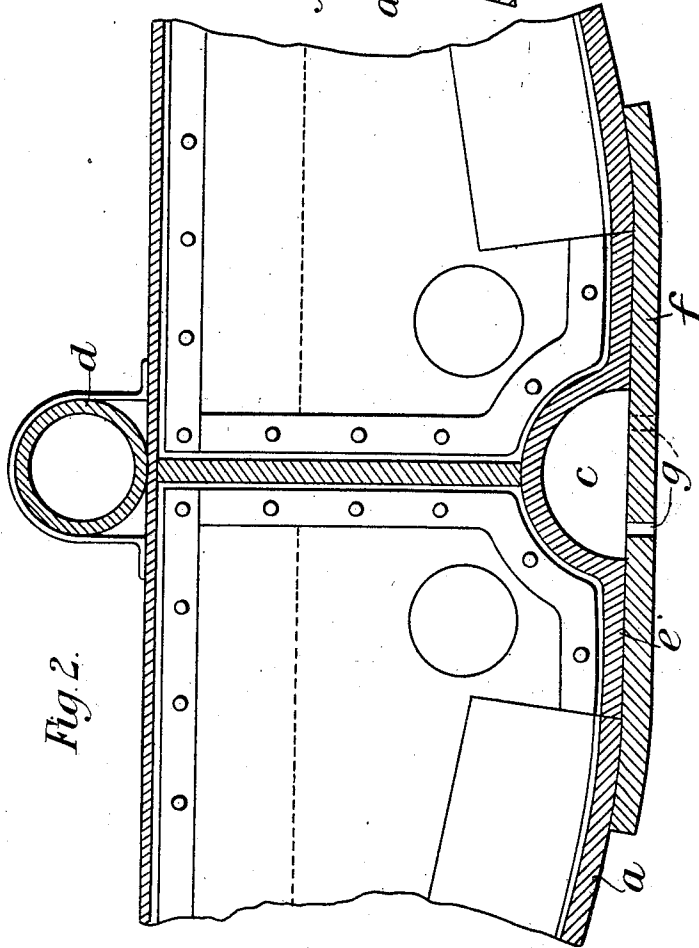


Fig. 2.



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UNITED STATES PATENT OFFICE.

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MEANS OF REDUCING THE RESISTANCE TO THE MOTION OF VESSELS THROUGH WATER.

No. 829,077.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CARLO DEL LUNGO, a subject of the King of Italy, residing at Regio Liceo, Spezia, in the Kingdom of Italy, have invented a new and useful Means of Reducing the Resistance to the Motion of a Vessel Through Water, of which the following is a specification.

This invention relates to a method of reducing the resistance to the motion of a vessel through water.

The resistance to the motion of a vessel through water is due to two causes—namely, the resistance offered by the water to cleavage by the hull of the vessel and the friction which is generated between the submerged surface of the hull and the water. The effect of the first of these resistances is modified largely by the shape of the hull of the vessel and the second by the area of the submerged surface of the hull. Each increases approximately in proportion to the square of the velocity of the vessel, so that their sum, which gives the total resistance to the motion of the vessel, also varies with the square of the velocity. Now it has been deduced from experiment that the frictional resistance can be expressed by the following formula—namely, $R = K d A V^m$ —where R equals the resistance; A , the area of the plane surface; V , the velocity; d , the density of the fluid in which the surface is moving, and K and m two coefficients, the values of which have been found experimentally. It will therefore be seen that to obtain a minimum of friction it is necessary that the factors K and d should be as small as possible, and since the factor K is a more or less fixed quantity it will be clear that any diminution of resistance must be effected by an alteration in the value of the factor d —that is to say, the density of the fluid in which the vessel moves. Now according to my invention I obtain this result by mixing air with the water in which the vessel moves. By this means not only is the density of the fluid diminished, but the air-bubbles, which are practically spherical and possess a rotary movement, also appear to reduce the viscosity of the fluid, and thereby effect a further diminution in the friction between the fluid and the vessel's hull.

In a suitable arrangement for carrying out my invention I make use of an air-compression pump or the like for providing the necessary quantity of air at a pressure sufficient to overcome the friction in the air-passages

and the external pressure of the water—that is to say, a pressure amounting to no more than two atmospheres. The compressed air is conveyed through a system of tubes to the vessel's hull, on the external surface of which it escapes below the water-line through a number of small holes, so that the air-bubbles escaping from these orifices brush against the surface of the hull and remain practically always in close contact with or adherent to it, or I make use of one or more tubes extending along the bow and the keel of the vessel for more or less the whole length thereof and having on both sides one or more rows of small perforations.

The number and dimension of the holes or perforations are preferably such that the air is ejected in the largest quantity at the bow end of the vessel, at which part the friction is the greatest. The air which is used may be that which is withdrawn by pumps from the condenser, or it may be air obtained directly from the atmosphere, or in lieu of air I can employ the exhaust-gases from internal-combustion or explosion engines, either alone or admixed with air.

In the accompanying drawings, Figure 1 is a longitudinal section of the hull of a vessel provided with suitable means for forcing compressed air from the said hull below the water-line in accordance with the invention. Fig. 2 is a section on the line 2 2, Fig. 1, drawn to a larger scale; and Fig. 3 is a section on the line 3 3, Fig. 1, also drawn to a larger scale.

a represents the hull of the vessel, b an air-pump located within the same, and c and d two pipes which extend from the air-pump and are supplied with compressed air by the same. The pipe c extends along the bottom of the hull and is in the form of a semicircular plate with lateral extensions e , by means of which it can be bolted to the keel-plate f , and thus form a closed tube. The keel-plate f is made with a number of orifices or holes g , placing the interior of the tube in communication with the outside of the vessel. The tube or pipe d is designed to supply the compressed air to the bow portion of the vessel, and to this end it extends along the fore part of the vessel parallel to the pipe c and on attaining the bow passes up the same to about the level of the water, as shown at h , Fig. 1, being secured in place by means of the side plates i , bolted to the hull of the vessel. Air-nipples or orifice-tubes j are inserted through holes in the hull and air-tube. With

this arrangement it will be clear that when the pump *b* is in operation air is forced through the pipes *c* and *d*. The air which enters the pipe *c* is discharged through the orifices *g g*, leaving the hull below the water-line in the form of bubbles, which brush against the surface of the hull *a* and remain more or less in contact with it. The air which is forced into the pipe *d* is discharged at the bow of the vessel through the nipples or orifices *j* and performs the same function as the air escaping through the holes *g*.

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

1. The combination with a vessel, of a keel-plate secured thereto and provided with a longitudinally-extending series of perforations; a pipe extending along said keel-plate said pipe comprising a semicircular plate provided with lateral extensions bearing upon said keel-plate and forming an air-passage along said keel-plate over said series of perforations therein; an air-supply device

and connections between said air-supply device and the interior of said air-passage, substantially as described.

2. The combination with a vessel, of a keel-plate secured thereto and provided with a longitudinally-extending series of perforations, a pipe extending along said keel-plate, said pipe comprising a semicircular plate provided with lateral extensions bearing upon said keel-plate and forming an air-passage along said keel-plate over said series of perforations therein; an air-supply device; connections between said air-supply device and the interior of said air-passage; an auxiliary pipe extending along the fore part of the vessel and up the bow to the water-line; nipples extending from the interior of said pipe through the hull of the vessel and connections between said air-supply device and said auxiliary pipe, substantially as described.

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Witnesses:

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