No. 640,946. Patented Jan. 9, 1900.

G. QUANONNE.

AIR EJECTING APPARATUS FOR VESSELS.

(Application filed Feb. 17, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

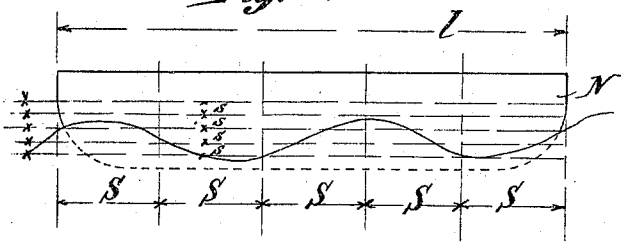


Fig. 3.

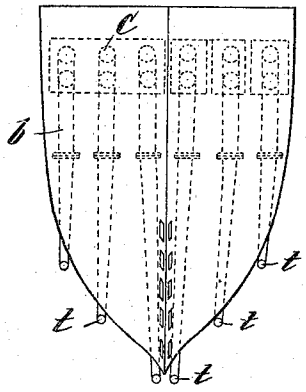


Fig. 2.

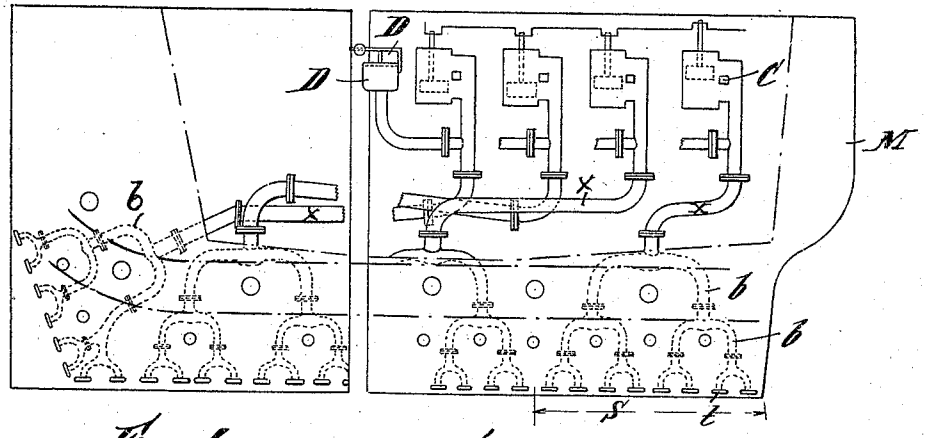


Fig. 4.

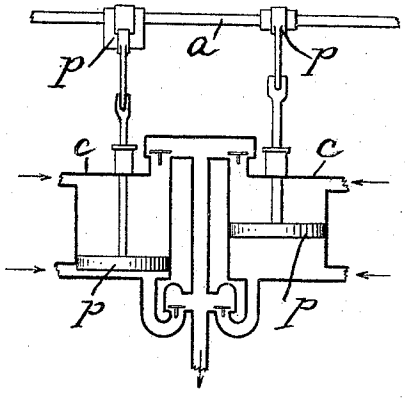


Fig. 5.

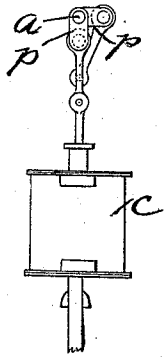
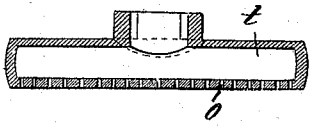


Fig. 6.



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(No Model.) 3 Sheets—Sheet 2.

Fig. 7.

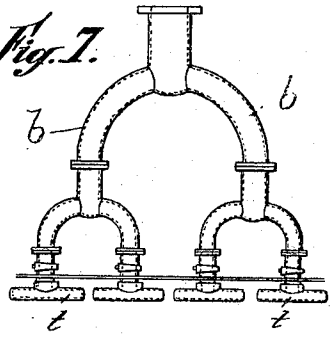


Fig. 8.

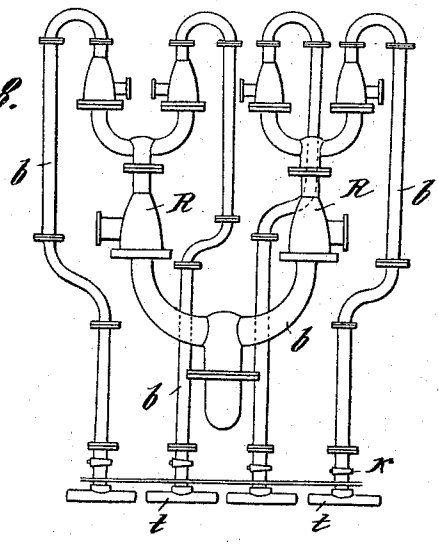


Fig. 9.

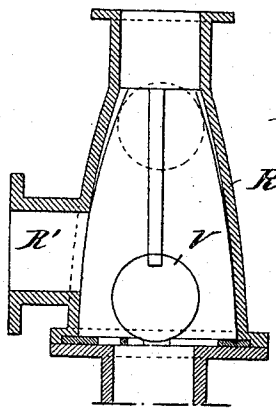


Fig. 10.

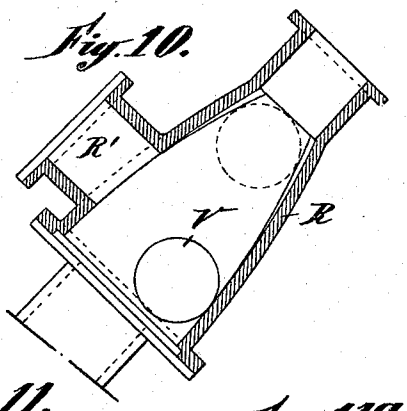


Fig. 12.

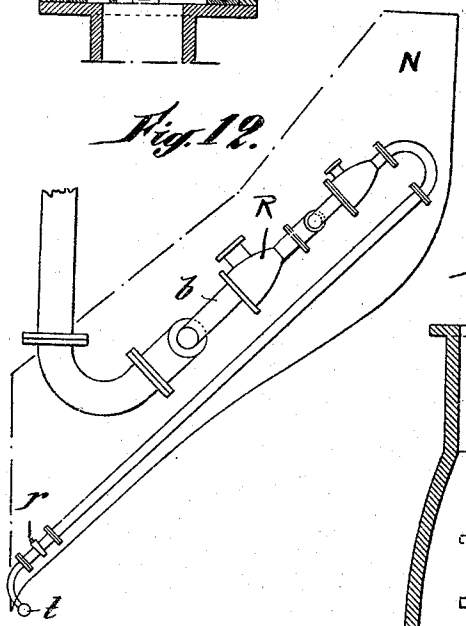


Fig. 11.

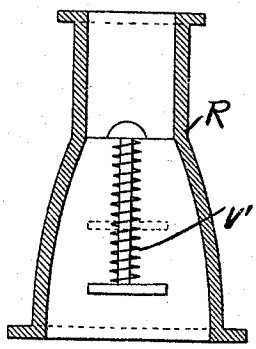
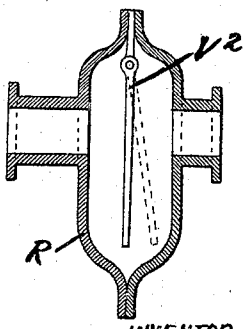


Fig. 11a.



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No. 640,946. Patented Jan. 9, 1900.

G. QUANONNE.

AIR EJECTING APPARATUS FOR VESSELS.

(Application filed Feb. 17, 1899.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 13.

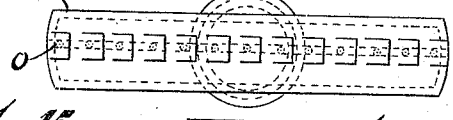


Fig. 15.

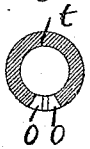


Fig. 14.

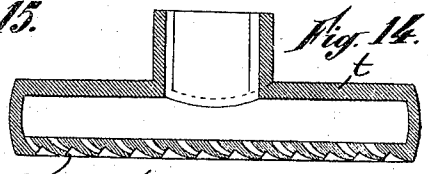


Fig. 16

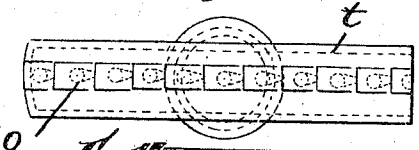


Fig. 11

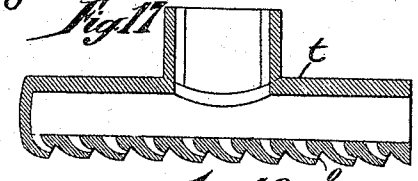


Fig. 19

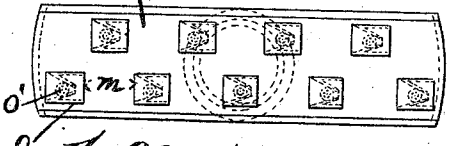


Fig. 20.

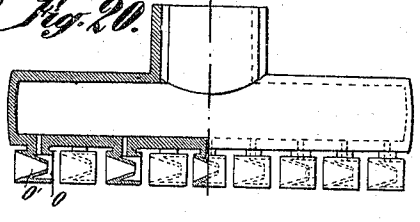


Fig. 23.

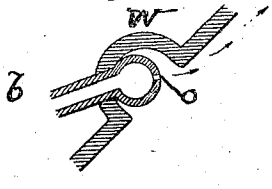


Fig. 24.

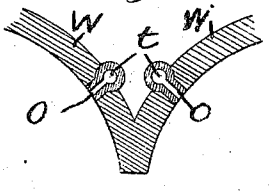


Fig. 25.

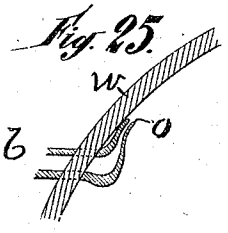


Fig. 26.

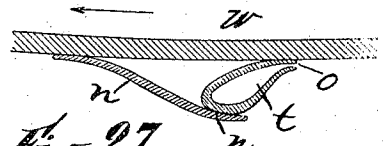


Fig. 27.

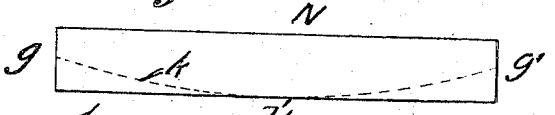


Fig. 18.

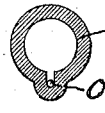


Fig. 28.

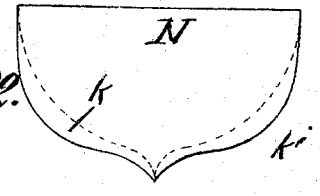


Fig. 22.



Fig. 21.

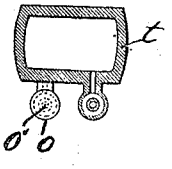
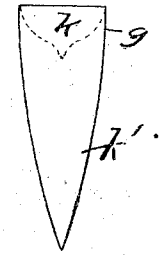


Fig. 29.



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UNITED STATES PATENT OFFICE.

GUSTAVE QUANONNE, OF HOUDENG-GOEGNIES, BELGIUM.

AIR-EJECTING APPARATUS FOR VESSELS.

SPECIFICATION forming part of Letters Patent No. 640,946, dated January 9, 1900.

Application filed February 17, 1899. Serial No. 705,842. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVE QUANONNE, a subject of the King of Belgium, and a resident of Houdeng-Goegnies, Belgium, have invented certain new and useful Improvements in Vessels, of which the following is a specification.

It is well known that the propulsion of vessels and other floating or submerged bodies can be facilitated by the introduction of a layer of air between the sides of the vessel and the surrounding water. The arrangements which have heretofore been devised for this purpose, however, have not provided for obtaining a uniformly constant and regulated supply of air when water is agitated. The incessant variation of the pressure of water due to the progression and propulsion of the vessel, to the waves, the rolling, pitching, &c., on the contrary caused great variations in the quantity of air supplied by reason of its extreme fluidity.

This invention has for its object to remedy these objections and to obtain the permanent, regular, and economic formation of a layer of air around the bodies of ships and floating or submerged bodies notwithstanding the incessant variations of pressure acting against the outlet of the air at the delivery-apertures thereof, the supply of air being effected according to a predetermined law by the shipbuilder or by the engineer of the ship.

My invention consists for this purpose in dividing the vessel throughout its length and width into distinct sections, to each of which rightly belongs a series of volumetric compressors, (piston-pumps or rotary pumps,) working by reduction of volume and compelling the pressure of air to follow and to subdue the opposition of water without limits, followed by an apparatus for effecting a regular distribution through pipes subdivided in branches, combined or not, according to requirement, with regulating discharge-valves. According to the principle of my invention the supply of air is divided, while the compressors are caused to work in unison through being dependent upon a single transmission, being a shaft, electrical transmission, or other having a uniform regimen of movement in order to maintain the uniformity of the quantity of air delivered. Consequently the characteristic of my invention is the forcing into each section, chosen on the submerged surface of the vessel, of a constant quantity in weight of air in a unit of time, but the pressure of which varies in proportion to the pressure to be overcome at the various submerged points selected for the delivery of the air. The quantity delivered will be limited everywhere to what is strictly necessary with the object of economy of mechanical work. At no point will it be found to be suspended for one moment. For a still stronger reason the counter-pressure will not overbalance the internal pressure, and thereby allow water to enter the distributers. In order to cause in each zone thus formed a distribution as equal and as constant as possible of the quantity of air supplied by each compressor, I subdivide each of the sections by a methodically-distributing apparatus, as hereinafter described.

Theoretically it would be necessary to provide each outlet-point for the air with a set of compressors, the law of hydrostatic pressures not being applicable, as already explained, and it would therefore be necessary to provide the vessel with thousands of compressors. This being impracticable, I unite the outlet-apertures for the air into groups, so that they may be fed by a reasonable number of compressors, each of the latter operating upon the differerent points of the corresponding group through the medium of a branched system of channels in combination with a set of valves according to requirements.

The ramificated pipes are combined with scanted passages or areas and with valves, so that they automatically prevent the excessive flow of air to any point of a zone of the distributers fed by the same compressor to the detriment of the remainder of this zone of distributers. They make the effect of a bridle automatically repressing the increasing of air quickness.

The accompanying drawings illustrate an example of one method of carrying out my invention.

Figure 1 shows a vessel floating in the water and will facilitate the explanation of my invention. Fig. 2 shows in side elevation a vessel propelled according to my invention. Fig.

3 is an end elevation of the said vessel. Fig. 4 is a front elevation showing the arrangement of two compressors coupled together and actuated by the same transmission-gear. Fig. 5 is a side elevation of the said compressors. Fig. 6 is a sectional view of an air-distributer. Fig. 7 shows the arrangement of pipes for feeding the distributers represented in Fig. 6. Fig. 8 shows another modification of the said arrangement completed by the addition of regulating-valves. Fig. 9 shows one of the regulating-valves separately in vertical section. Fig. 10 is a similar section of the same kind of valve arranged obliquely. Figs. 11 and 11[a] are vertical sections of two other forms of the said valves. Fig. 12 is a diagrammatic view illustrating the arrangement of the whole of the distributing-pipes combined with the valves and distributing-apertures in the interior of the hull of a vessel. Figs. 13, 14, and 15 are respectively a plan, a longitudinal section, and a transverse section illustrating a modification of the distributer represented in Fig. 6. Figs. 16, 17, and 18 are corresponding views of another modification of the said distributer. Figs. 19, 20, and 21 are respectively a plan, a longitudinal section, and a transverse section of a third modification of the said distributer. Fig. 22 is a sectional view, drawn to a larger scale, of a structural detail of the distributer represented in Figs. 19, 20, and 21. Figs. 23, 24, 25, and 26 show different arrangement of mouths for the discharge of the air and the combination of the said mouths with the sides of the vessel. Figs. 27, 28, and 29 are diagrammatic views illustrating different modifications in the form of the hulls of vessels proposed with the object of facilitating the application of my invention.

As shown in Fig. 1, I divide the vessel N throughout its length and height into given sections S, independent of one another. These sections are each fed separately by a special compressor C, Fig. 2, or by a group of compressors C, coupled together, Figs. 4 and 5. These compressors C are arranged, for instance, on each side of the axis of the vessel N and actuated by the propelling-engine or by any suitable motor. Their pistons P are, as shown in Figs. 4 and 5, connected to a common transmission-shaft *a* by means of cranks *p*, keyed at different angles, as hereinbefore explained. Each compressor C, Fig. 2, or each group of compressors C, Figs. 4 and 5, furnishes the compressed air necessary for feeding one section S of the vessel N, and the distribution in each of the said sections is effected through the medium of pipes *b*, Figs. 2 and 7, branched or subdivided and conducting the air to the "distributers," properly so called, which are placed along the sides of the vessel and consist, for example, of T-shaped tubes *t*, Fig. 6, made with round or other suitably-shaped holes *o*. Several lines of similar distributers *t* can obviously be arranged in step fashion on each side of the keel of the vessel, Fig. 3. Experience will point out the form and the drawing of these lines according to the form and the speed of the vessel.

Instead of simple pipes *b*, branched or subdivided, as represented in Fig. 7, I can employ one of the forms represented in Figs. 9, 10, 11, and 12 of the accompanying drawings. I interpose as a means of division between the main pipe and the distributers light balls V for regulating the flow, Figs. 9 and 10, placed in suitable cases R, these balls being adapted to be lifted, as already stated, under the action of the *vis viva* of the air under pressure when a sudden depression is produced in the distributers *t*. The lifting of the ball V, bringing it into the part of the case through which the air is flowing, causes a diminution of sectional area of the said casing, and consequently a reduction of the speed of flow. The same arrangement can be employed by making use of relatively heavy metal balls V under such conditions as to provide an inclined trajectory for the said balls, as shown in Fig. 10. In this case the arrangement of the pipes *b* instead of being vertical, as in the case of Figs. 8 and 9, will necessarily be oblique and inclined, as shown in Fig. 12.

Instead of spherical valves any other suitable form may be employed, such as the spring-valve V′ or the oscillating valve V[2], (Represented separately in Figs. 11 and 11[a], for example.) Whatever the kind of valve employed it can be inspected through a lateral sight-hole R′, Figs. 9 and 10.

Another means of regulating slight variations, which might still be produced in spite of the breaking up or dividing caused by the distributing-pipes, can consist in the employment, in combination with each air-compresser C, of an air-reservoir D, such as represented in Fig. 2, acting as a regulator for momentarily compensating any accidental differences in the supply to the distributers *t*.

Until now I have not assigned any particular arrangement to the distributers *t*. They may consist of simple T-shaped pieces adapted to be easily detached from the exterior of the vessel and provided with holes *o* of round or other form. (See Fig. 6.) The cleaning or replacing of these distributers can be easily effected by simply unscrewing them after having closed the cock *r*, placed at the end of each pipe *b*, Fig. 12. These distributers may, however, be of a form more appropriate to the purpose for which they are to be used and of a nature, especially for high rates of speed, to assist the work of the air-compressors necessary for obtaining a given result, and even to render them superfluous in the case of extra high speeds, toward which maritime transportation is tending. Such are, for example, the forms represented separately in Figs. 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22. In the forms represented in Figs. 13, 14, 15, 16, 17, and 18 the holes *o* consist of small passages arranged in a direction opposite to that of the travel of the vessel and projecting in order to form a

furrow in the water. In the form represented in Figs. 19, 20, 21, and 22 these passages surround cones *o'*. It will be easily understood that owing to these arrangements the water circulating along the walls of the vessel can exert a certain suction upon the openings *o*. This suction will be particularly pronounced in the case of Figs. 19, 20, 21, and 22, in which the cones *o'*, extending into the center of the openings *o*, really act as aspirators. Naturally it will be convenient to allow a certain space *m* between two consecutive holes *o* or to arrange them quincuncially in two or three rows in order to prevent the working of one of the aspirators from reversing the working of that immediately adjacent. A wire *f*, (see Fig. 22,) a rib, or other accessory will protect them from becoming choked with the matters in suspension in the water.

The pipes *b* can be let into the walls W, as shown in Figs. 23 and 25, or can have their discharge-openings *o* juxtaposed in these walls W, as shown in Fig. 24, in such a manner as to better insure the introduction of the air between the body of the ship and the water. The pipes can also be let into the upright or vertical parts. They are concealed, for example, by means of sheet metal *n*, as shown in Fig. 26, in order to prevent the said pipes from causing eddies liable to impede the progress of the vessel.

The form of the body of the vessel N can obviously be modified in such a manner that it shall offer no opposition to the free formation of the layer of air. Figs. 27 and 29 show one special form raised at the front *g* and back *g'*, which will be particularly advantageous, the inclinations of the outlines being thus more accentuated. These figures show the form proposed in dotted lines *k* and the form at present in use in full lines *k'*. Fig. 28 in the same way shows comparatively the present form *k'* of section of midship beam (drawn in full lines) and the form *k* proposed, (drawn in dotted lines.)

I claim—

1. In combination with a vessel, a series of distributers disposed along the sides and ceiling of the vessel at different points forming or grouped into separated zones of distribution, a series of pipes leading to the distributers, a series of compressors connected with the pipes and means for automatically regulating the flow of air toward the distributers whereby a constant quantity of air will be delivered at different points of a same zone of distribution along the sides and ceiling of the vessel in a unit of time, the pressure of which varies with the variable counter pressure to be overcome at the various submerged points, substantially as described.

2. The combination with a vessel and with its body of compressors operating by reduction of volume, of branched pipes into which the said compressors force air, means for automatically regulating small variations of pressure in these pipes, and distributers connected to the said pipes and distributing the compressed air over different sections of the body independently of one another, substantially as described and for the purpose set forth.

3. The combination with a vessel and with its body of compressors operating by reduction of volume, a single transmitting means having a uniform regimen of movement actuating the said compressors, branched pipes into which the said compressors force air, means for automatically regulating small variations of pressure in the said pipes, and distributers connected to the said pipes and distributing compressed air over different sections of the body independent of one another, substantially as described and for the purpose set forth.

4. The combination with a vessel and with its body of compressors operating by reduction of volume, a single transmission-shaft actuating the said compressors, cranks keyed at different angles connecting the said compressors to the said single transmission-shaft, branched pipes into which the said compressors force air, means for automatically regulating small variations of pressure in the said pipes, and distributers connected to the said pipes and distributing the compressed air over different sections of the body independent of one another, substantially as described and for the purpose set forth.

5. The combination with a vessel and with its body of compressors operating by reduction of volume, a single transmission-shaft actuating the said compressors, cranks keyed at different angles connecting the said compressors to the said single transmission-shaft, a regulating-reservoir for the continuity of the air-current, branch pipes into which the said compressors and the said reservoir force air, means for automatically regulating small variations of pressure in these pipes and distributers connected to the said pipes and distributing the compressed air over different sections of the body independent of one another, substantially as hereinbefore described and for the purpose set forth.

6. The combination with a vessel and with its body of compressors operating by reduction of volume, a single transmission-shaft actuating the said compressors, cranks keyed at different angles and connecting the said compressors to the said single transmission-shaft, a regulating-reservoir for the continuity of the air-current, branched pipes into which the said compressors and the said reservoir force air, ball-valves interposed in the said pipes and acting through the effect of the *vis viva* of the air-current to moderate the latter, and distributers connected to the said pipes and distributing the compressed air over different sections of the body independent of one another, substantially as described.

7. The combination with the vessel and with its body of compressors operating by re-

duction of volume, a single transmission-shaft actuating the said compressors, cranks keyed at different angles and connecting the said compressors to the said single transmitting-shaft, a regulating-reservoir for the continuity of the air-current, branched pipes into which the said compressors and the said reservoir force air, ball-valves interposed in the said pipes and acting through the effect of the *vis viva* of the air-current to moderate the latter, distributers connected with the said pipes and distributing the compressed air over different sections of the body independent of one another and means for concealing the said distributers in the sides of the vessel.

In witness whereof I have hereunto set my hand in presence of two witnesses.

GUSTAVE QUANONNE.

Witnesses:

GREGORY PHELAN,

GEORGE BEDE.