A. GUSSI.

SHIP.

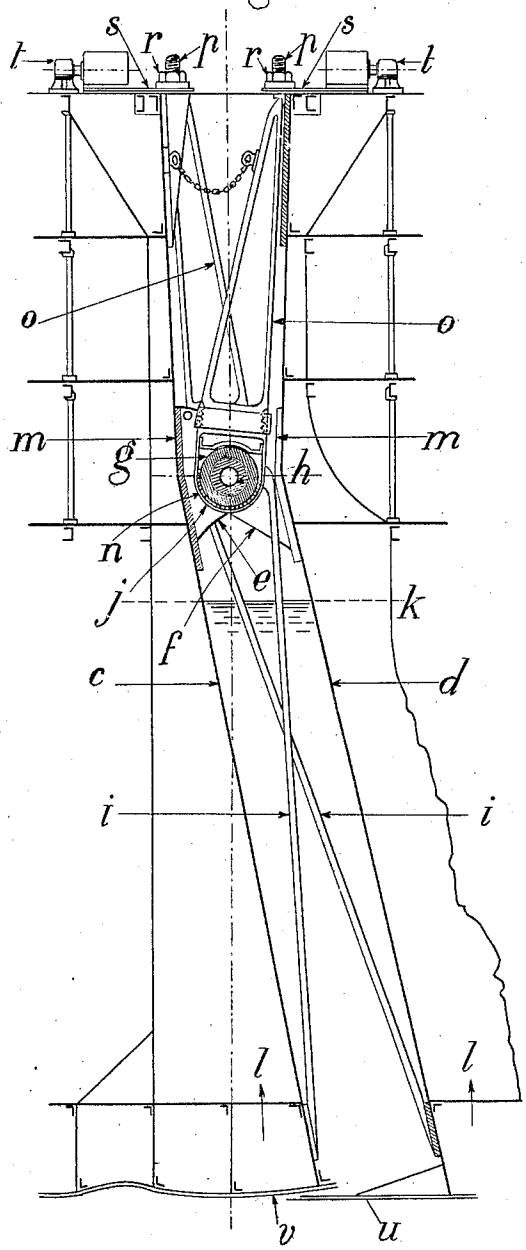
APPLICATION FILED NOV. 9, 1918.

1,363,039.

Patented Dec. 21, 1920.

2 SHEETS—SHEET 1.

Fig. 1



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2 SHEETS—SHEET 2.

Fig. 2

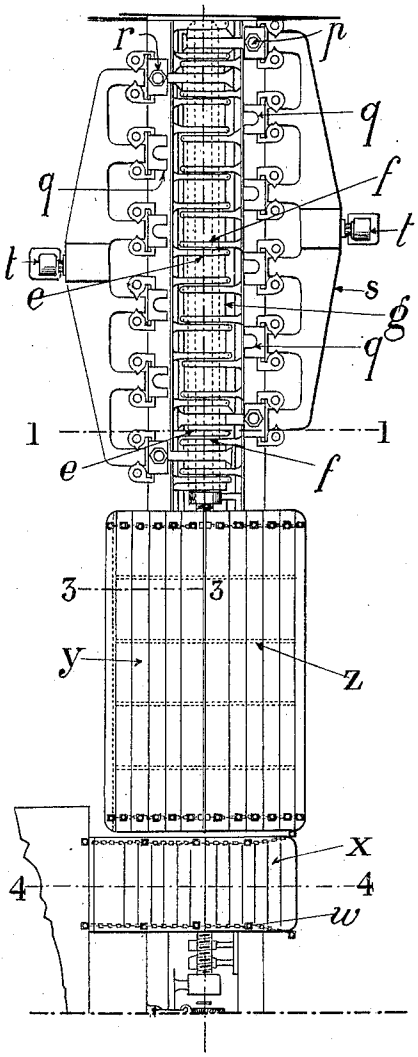


Fig. 3

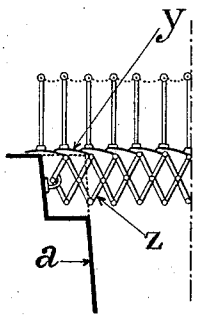
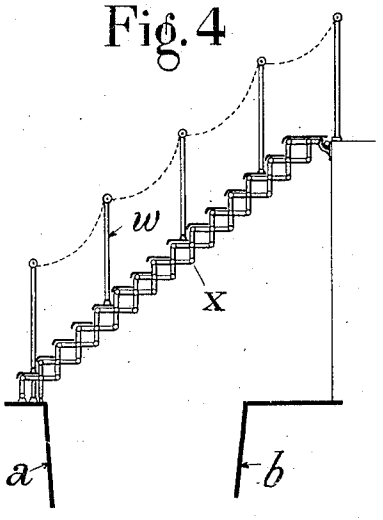


Fig. 4



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UNITED STATES PATENT OFFICE.

ARNALDO GUSSI, OF MILAN, ITALY, ASSIGNOR TO GIORGIO RABBENO, OF LEGHORN, ITALY.

SHIP.

1,363,039. Specification of Letters Patent. Patented Dec. 21, 1920.

Application filed November 9, 1918. Serial No. 261,870.

To all whom it may concern:

Be it known that I, ARNALDO GUSSI, gentleman, a subject of the King of Italy, and residing at Milan, Italy, whose post-office address is Via Spiga No. 25, have invented certain new and useful Improvements in Ships, of which the following is a specification.

The present invention relates to an improvement in shipbuilding and its object is to have the hull formed of two or more elementary hull sections connected to one another by articulated joints. The invention is applicable to vessels made of any suitable material (steel, wood, armored concrete, etc.) Hereinafter, for the sake of brevity, reference will be made only to steel vessels, but it is understood that what is said of these equally applies to any other vessels.

The object of the invention is to lessen the danger of total loss of the vessel or of goods and life in case of fire, stranding, collision or in the case of explosions.

This object is attained by building the hull of the vessel in independent sections held together by hinges adapted to be readily disconnected.

As is well known the weight of a ship is greatly increased by the necessity (which has thus far been regarded as an absolute one) of securing the longitudinal stiffness of the hull considered as a beam; on the contrary, however, the nautical quality of the ship requires that the weight be not increassed in proportion to increased length. This condition of things is at once removed if the vessel be made in two or more sections connected to one another by means of very strong hinges adapted to take up the bending moments just where such stresses would have their maximum value, on the ship passing over the waves.

The advantages of the novel construction are of course more substantial with ships of large dimensions, in that the new construction enables the ship's draft to be reduced as may be desired and removes practically all limits to the ship's length that may be set by technical or commercial considerations.

By so designing the hinges that the vessel can be readily separated into parts in case of serious damage, the hull section can be disconnected from the other section or sections and a substantial portion of the ship's cargo and all men's lives can thus be saved. Moreover, a large vessel can thus be built on two or more small slips; can be docked in separate small docks in two or more parts; can be loaded separately along two or more piers; and can be hauled separately into narrow harbors.

In order that the invention may be clearly understood the following description and annexed drawing refer to the example of a high speed passenger and cargo steamer with steel hull, consisting of only two sections in order to show the hinge connection under the most unfavorable conditions; as with three sections the stresses would be by far less and the solution of the problem would be far more convenient. Under the worst circumstances, namely when the wave length from crest to crest equals the length of each hull section, the shearing stress on the hinges (which may be assumed to be two in number, one on each side of the ship, or midway of the hull length, or preferably midway of the cross plane containing the keel center) will be a reasonably small fraction of the total weight of the ship.

The problems of securing the desired mechanical strength and of preventing the hinge connections becoming loose through wear of the working surfaces, while allowing instantaneous disconnection of the ship's sections in case of damage are compeltely solved by the adoption of adjustable, double fastening, multiple hinges capable of being disconnected and having the wearing parts capable of being all readily replaced. In any event the wear of such parts is very slow, since the bushes (in which only one half must take up the calculated stress) can be so designed that the maximum stress per unit area of the projected bush surface is kept fairly low.

No fear need be entertained regarding the discontinuity of the keel line involving an appreciable instability in the route line, since the rolling maxima generally coincide with the pitching minima and vice versa regardless of the direction of the waves relatively to the ship's bow. The pitching motions will be materially damped and in some cases it may be advisable to provide a rudder under the stem post of the foreward hull section, the action of this rudder being opposite to that of the ordinary rudder.

In the annexed drawing:

Figure 1 is a longitudinal section, along the line 1—1 in Fig. 2, where the two hull sections are hinged to one another.

Fig. 2 is a plan view of half the ship's width above the point between the sections.

Fig. 3 is a section through 3—3 in Fig. 2.

Fig. 4 is a section through 4—4 in Fig. 2.

Each section —*a*— and —*b*— of the hull is fitted with a strong end bulkhead —*c*—, —*d*—. Each bulkhead is suitably stiffened and has firmly secured to it a set of multiple-hinge-halves —*e*—, —*f*—. That is to say sets of alternately arranged lugs are provided on the two bulkheads in such a way that those of one bulkhead accurately fit into the recesses left between the lugs of the opposite bulkhead, bronze sleeves —*g*— being interposed between the adjacent lugs. A hollow steel spindle —*h*— is threaded through the lugs on each side of the ship and stiff tie-rods —*i*— connect the lugs —*e*— and —*f*— to the double bottom —*l*—, the tie-rods —*i*— being secured to the double bottom in way of the knees where the ship possesses the maximum strength so that the stresses transmitted by the tie-rods are distributed over the whole hull.

If all stresses were, however, to pass through the hinge spindles, the bronze sleeves would wear out too rapidly and require too frequent replacing in order to prevent excessive looseness of the connections between the hull sections and consequent heavy shocks, and to obviate this a further set of joints is provided which are intended to take up all ordinary and continuous stresses of medium importance set up by small oscillations, are adjustable so as to permit the same to be always maintained in tension even when the working surfaces are worn out and, assist the hinge spindles in withstanding exceptional stresses due to heavy rolling during storms, in that such stresses are distributed in nearly equal halves over the said additional connections and the hinge spindles, the maximum stress per unit area of the working surfaces being a limited one also in this case.

In order to attain this end, the intermediate cylindrical portion —*g*—, provided between two adjacent lugs —*e*— and —*f*— and fitted between the two brackets or flanges that connect the lugs to the plate —*m*— connecting the latter to the sections —*a*— and —*b*— is surrounded by a hard steel half-cylinder —*n*—, which is separately turned and can be easily removed for the sake of replacement, this half-cylinder in its turn being embraced by a semicircular bronze bush —*j*—, which is supported by an iron fork —*o*— capable of being taken asunder for erecting and replacing purposes, this fork (as shown in Fig. 1) ending at the top in a screwthreaded bolt —*p*—. The substantial nut —*r*— screwed thereon rests, through the intermediary of a thick-rectangular washer, on forks —*q*— projecting from the top end of the bulkhead opposite the lug in question, where the bulkhead is connected to the main deck, and in such a position, of course, the fork, bulkhead and deck must make a quite rigid whole, suitably strengthened and firmly secured to the rest of the hull. The nuts —*r*— constitute connections between the two hull sections additionally to the hinge spindles, which in this case only secure the transmission of the larger portion of the longitudinal thrusts and horizontal stresses and, as mentioned, are not subjected to exceptional stresses. The remaining stresses are taken up by the tie-rods, which are inclined to the vertical. Should this inclination attain 30°, the resistance would be the same in all directions and equal to that of the hinge spindles.

The spindles —*h*— as well as the nuts —*r*— can be threaded out of engagement instantaneously. By a mechanical means (for instance motor-operated screw-shafts, or hydraulic cylinders or pneumatic cylinders controlled from a navigation platform or other post at a distance provided with an emergency hand controlling gear) the spindles —*h*— can be withdrawn directly toward the ship's center line and for this reason the spindles of each set of hinges should preferably be less than $\frac{1}{4}$ of the ship's breadth. The nuts —*r*— are disengaged from the supporting forks by means of a sliding or revolving plate —*s*— operated by a motor —*t*— and actuating the nut washers. The same parts, by means of suitable wedges that can be operated from a distance, serve to prevent an untimely disengagement of the spindles and nuts.

In order to prevent the eddying motion of the water in the space left between the two hull sections, the edge of the bow section is fitted with a plain metal plate covering —*u*— which overlaps the edge —*v*— of the stern section. In this way the liquid mass between the two sections can circulate freely, but for the most part is advanced with the ship.

At main deck's level the free space between the two sections can be bridged by hinged passages, for instance by horizontal platforms —*y*— of imbricated construction carried on hinged lattice supports —*z*— as shown in Fig. 3 or by hinged ladders —*x*— fitted with telescopic or otherwise expanding railings —*w*— as shown in Fig. 4. The ship's stamping motions always have a period of some seconds and consequently the relative movements will not make the walking over such passages more difficult than the other usual ship's movements.

The hinge connections should preferably be arranged somewhat above the full-load-water line —*k*— in order that they may always be accessible for inspection and lubrication. The hinged joints can be disconnected even while they are actually at work, especially by first withdrawing the hinge spindle and then releasing the tie-rods. In order to couple up the hull sections, however, it will be necessary for the sections to float in tranquil waters and to be brought near one another. The disconnecting and connecting up again, however, can be considered as exceptional operations, unless it be the question of true sea-trains built up of sections. In the latter case the forward end of bulkheads of the intermediate sections can be made cylindrical and therefore interchangeable and the number of the intermediate sections can be varied; the propelling apparatus could then be installed in the stern section or in the center section (by adopting paddle wheels or screw propellers arranged in recesses formed in the bottom or in the sides or, preferably, in the ground knees of the hull) or in both.

The details entered in the drawing have the sole object of illustrating the invention and demonstrating that there are no special difficulties in the construction, even in the case of very large ships made in two sections, but for large ships the division of the hull into three sections will always be preferable.

Having now described my invention and how the same is to be carried out, what I claim as my invention, is:

1. Articulated hull ship consisting of a number of independent sections alined in a fore-and-aft direction, and hinge means between adjacent ends of the sections comprising transverse hinge members located at the sides of the ship and adapted to be withdrawn toward the center line of the ship to disconnect the sections.

2. Articulated hull ship consisting of a number of independent sections alined in a fore-and-aft direction and transverse hinges detachably connecting the sections together and comprising transverse spindles engaging hinge elements carried on adjacent end bulkheads, connections between the hinges and the deck structure, and other connections between said hinges and the bottom structure of the ship.

3. Articulated hull ship consisting of a number of hull sections arranged in fore-and-aft alinement, transverse hinge spindles connecting the sections, means for securing the hinge spindles and means for releasing the hinge spindles to permit the withdrawal thereof and the disconnection of the hull sections from each other.

4. Articulated hull ship consisting of a number of independent sections alined in a fore-and-aft direction, hinges detachably connecting the sections and articulated communicating means between the sections.

In testimony whereof, I affix my signature.

ARNALDO GUSSI.