

T. B. TAYLOR.
PROPELLING MEANS FOR VESSELS.
APPLICATION FILED JUNE 17, 1905.

1,065,479.

Patented June 24, 1913.

4 SHEETS—SHEET 1.

Fig. 13

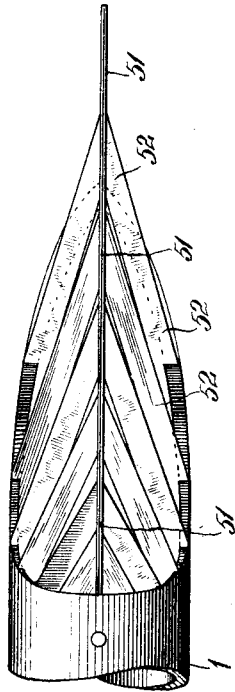


Fig. 12

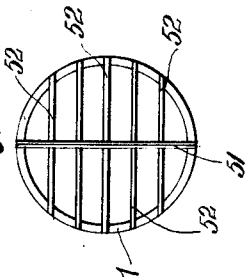
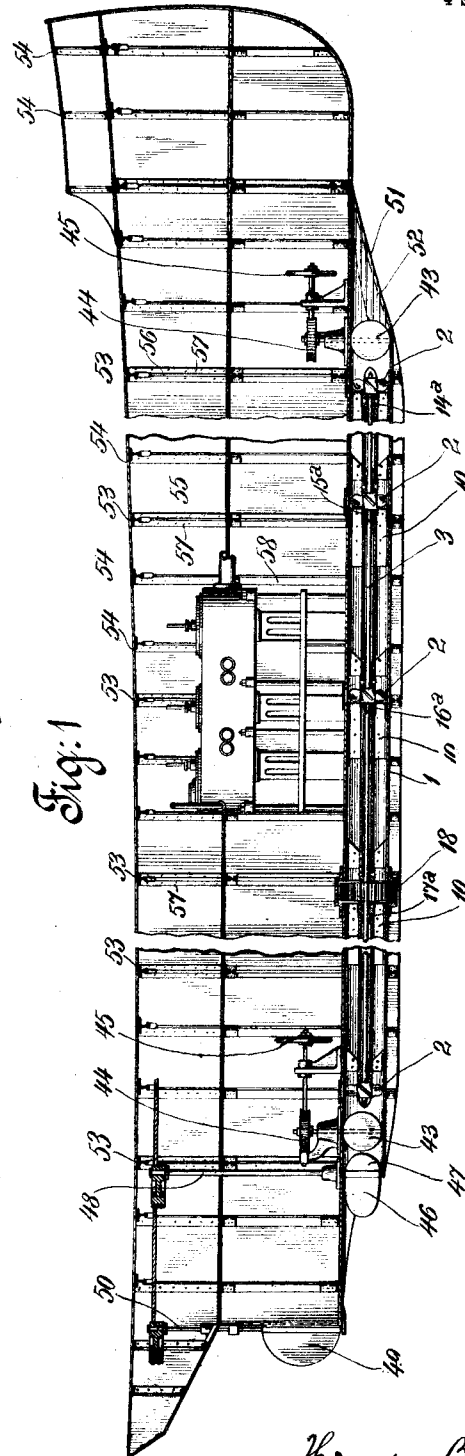


Fig. 1



Witnesses
Edmund Harris.
John O. Gemples.

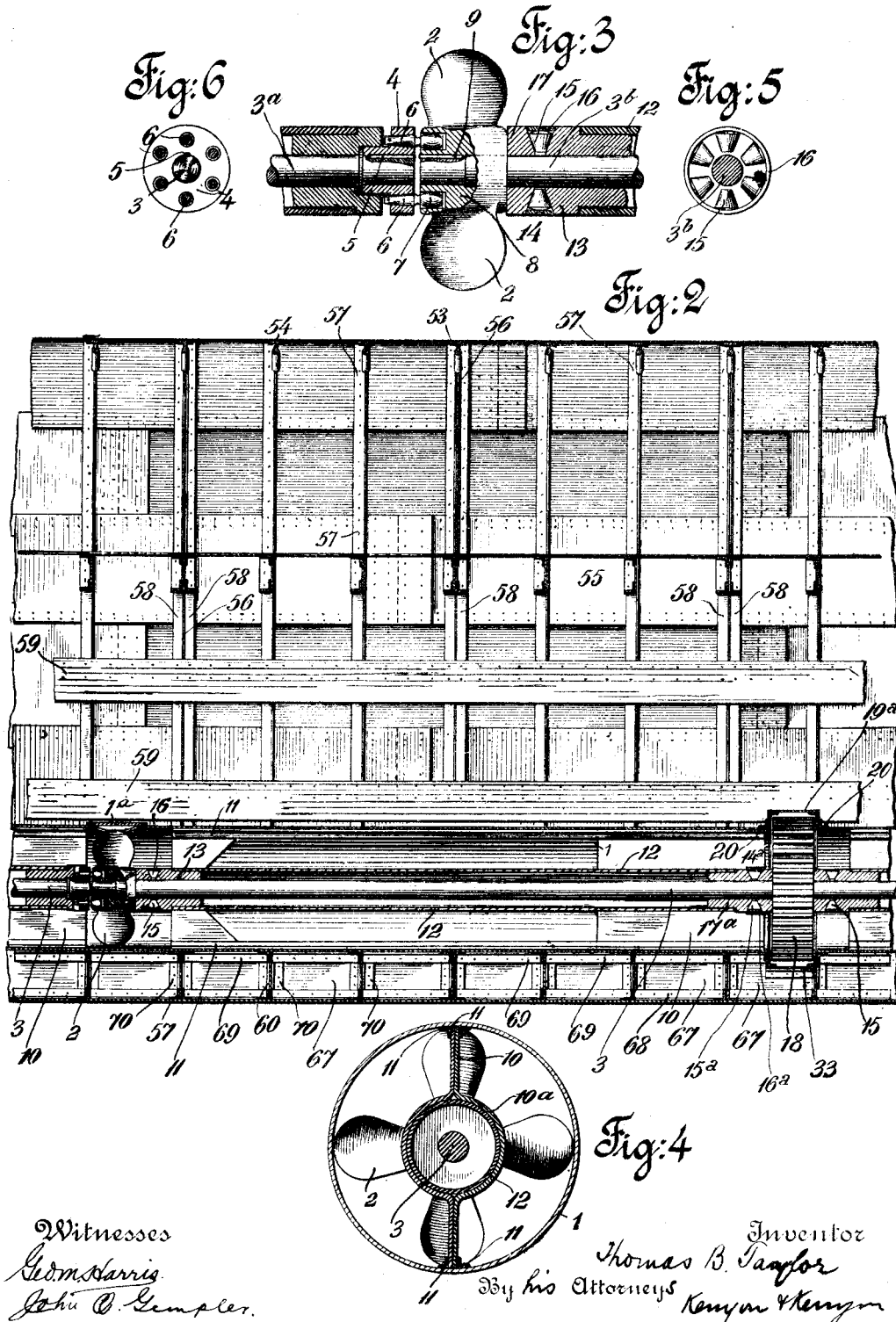
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4 SHEETS-SHEET 2.



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4 SHEETS—SHEET 3.

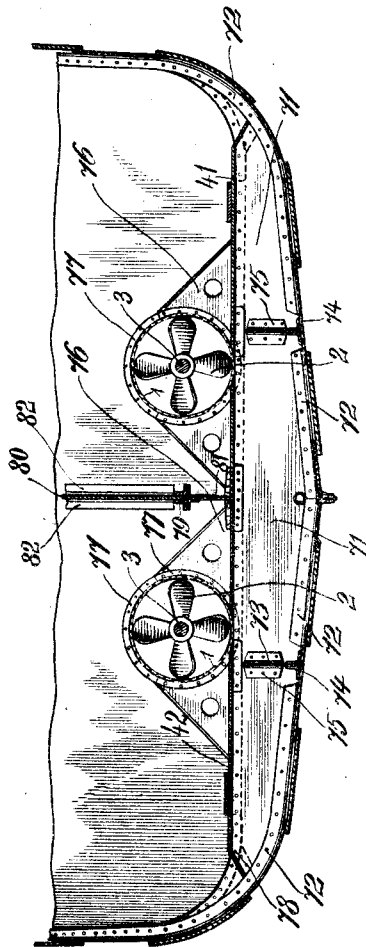


Fig. 2

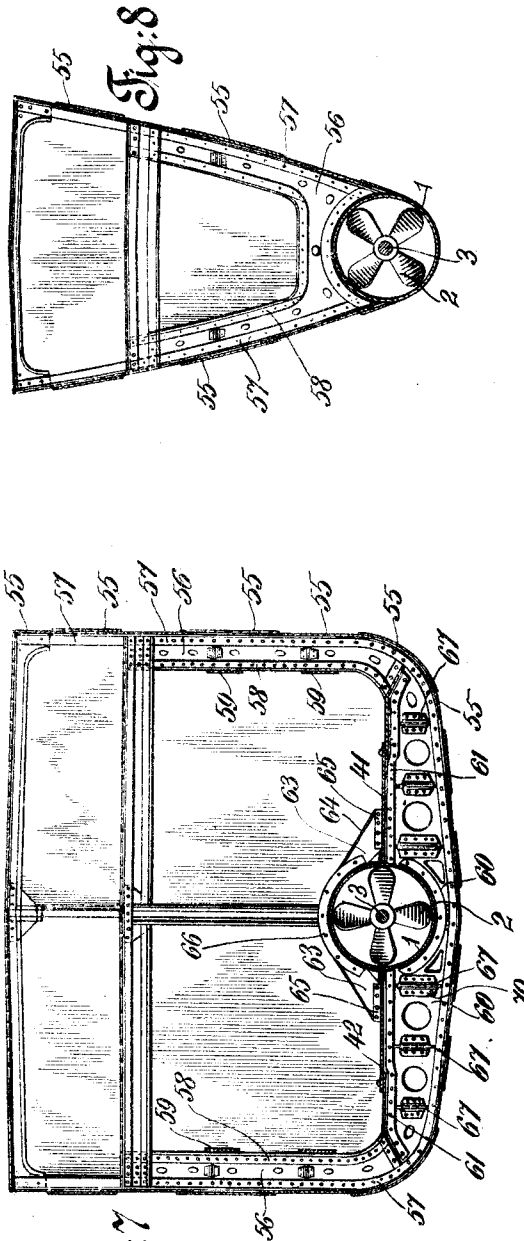


Fig. 1

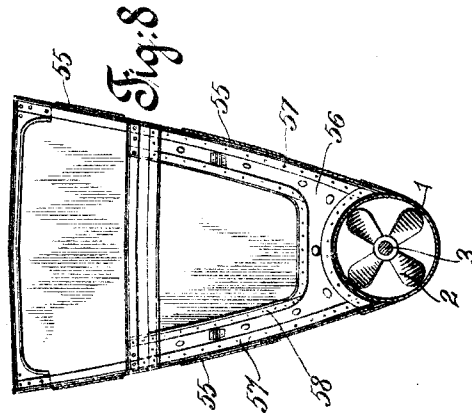


Fig. 8

Witnesses
 Edm. Harris.
 John C. Lempier.

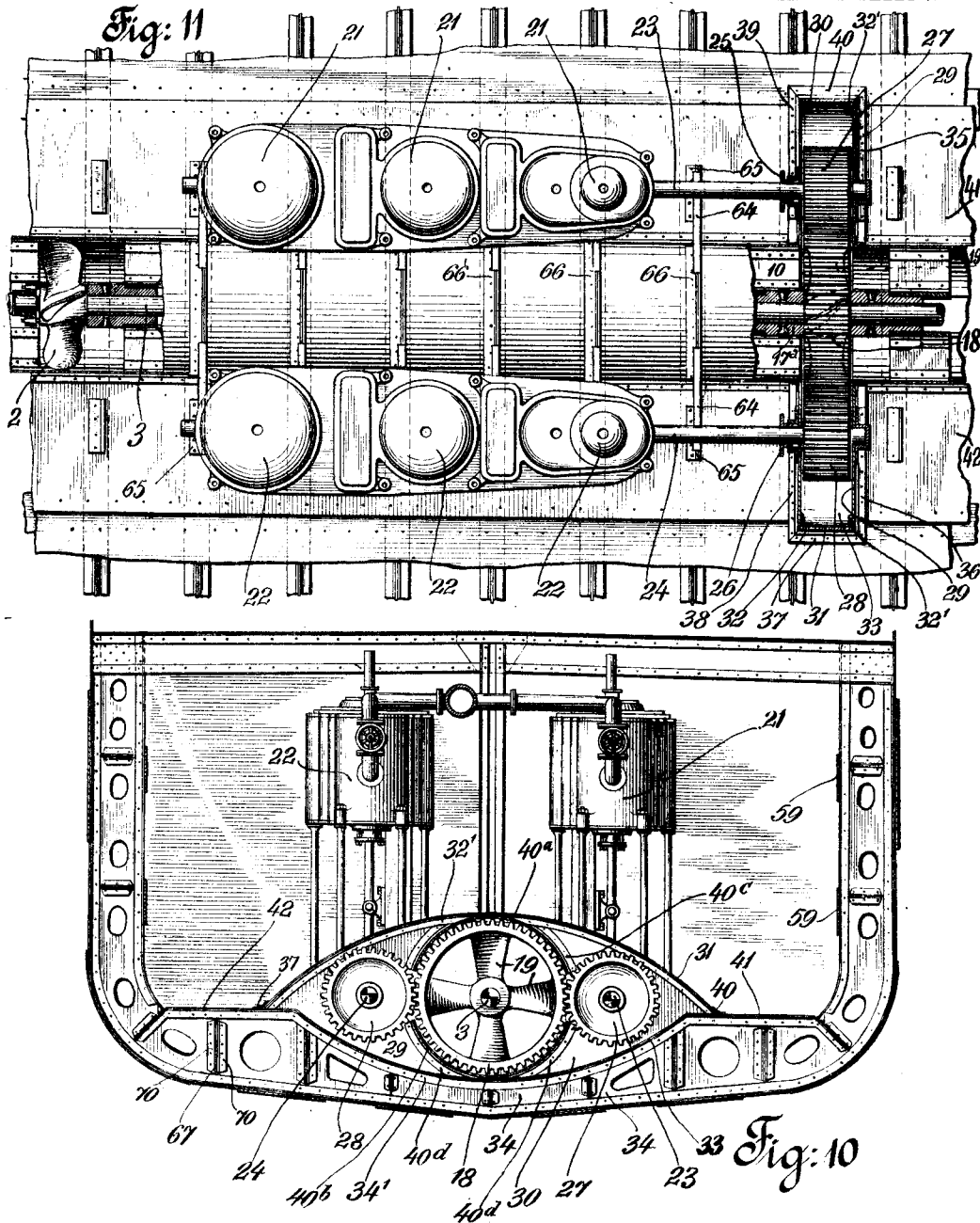
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4 SHEETS—SHEET 4.



Witnesses
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UNITED STATES PATENT OFFICE.

THOMAS B. TAYLOR, OF NEW YORK, N. Y.

PROPELLING MEANS FOR VESSELS

1,065,479.

Specification of Letters Patent.

Patented June 24, 1913.

Application filed June 17, 1905. Serial No. 265,658.

To all whom it may concern:

Be it known that I, THOMAS B. TAYLOR, a citizen of the United States, and a resident of New York city, county and State of New York, have invented new and useful Improvements in Propelling Means for Vessels, of which the following is a specification.

The object of my invention is to provide a propelling means for vessels which will increase their speed by the expenditure of a predetermined amount of power.

A further object of the invention is to avoid cavitation by the propeller blades.

A further object of the invention is to provide an improved construction of a propelling mechanism whereby the propelling mechanism is enabled to strengthen the hull of the vessel in a longitudinal direction.

My invention relates to propelling means for vessels in which a water way is provided, preferably within the hull of the vessel, and in which water way a plurality of propelling means cooperate to propel the vessel; the water way consists, in the best embodiment of my invention, of a tube the cross-section of which is small when compared with the cross-section of the greatest submerged section of the vessel. In the preferred embodiment of the invention the cross-section of the tube remains uniform and the tube contains no sudden and marked enlargements to create eddies and loss of energy. A plurality of propellers spaced so as to give the maximum effect, and avoid cavitation is mounted in the tube. In the best embodiment of the invention suitable means are provided to prevent the swirl of water in the tube from being produced by the propellers. In the form of the invention illustrated in the drawings dividing plates are used which also provide a means for supporting the shaft of the propellers within the tube.

My invention consists in the novel parts, improvements and combinations hereinafter shown and described and pointed out in the claims.

Referring now to the drawings which form a part of the specification: Figure 1 is a vertical longitudinal section of a vessel showing the propelling means. Fig. 2 is a detailed longitudinal section through the propelling means. Fig. 3 is a detail view showing one of the propellers and related parts. Fig. 4 is a transverse section through

the propeller tube. Fig. 5 is a detail of a roller thrust bearing. Fig. 6 is a sectional detail of the shaft coupling. Fig. 7 is a transverse section through a midship section of the vessel showing the double bottom. Fig. 8 is a transverse section through a forward section of the vessel. Fig. 9 is a transverse section showing another form of my invention with two propeller tubes. Fig. 10 is a transverse section showing the double bottom. Fig. 11 is a plan view partly in section showing the inner bottom. Fig. 12 is a front view of the guard. Fig. 13 is a bottom plan view of the guard.

In the drawings which illustrate two embodiments of my invention I have shown the water way in which the propelling means for the vessel are located, as consisting of a tube 1. This tube, in one embodiment of the invention, is substantially uniform in its cross-section throughout its length and the cross-sectional area of the tube is small compared with the cross-sectional area of the greatest submerged section of the vessel. In accordance with my invention, I mount in the tube a plurality of propellers 2. These propellers are spaced a suitable distance apart so as to enable them to produce a maximum thrust in propelling the vessel. I have found that by using a plurality of propellers in a water way, in order to drive the vessel, the addition of each additional propeller, will materially add to the driving effect of the system of propellers, although the same predetermined amount of power is used to drive the vessel in each case.

When a propeller is in open water, it creates a difference in pressure forward and aft of the propeller. A more or less complete vacuum is produced forward of the propeller, and a more or less sharply defined maximum of pressure is produced aft of the propeller. The former effect is a kind of cavitation. It is this difference in pressure that measures the thrust upon the propeller shaft. I have, as a result of my experiments, discovered by placing a plurality of propellers in a tubular water way, that with the same expenditure of energy, the difference in pressure produced by each propeller is reduced but the thrust upon the propeller shaft is increased. Each propeller is in the sphere of influence of the other, and the pressure produced by one tends to overcome the cavitation produced by the next propeller of the series. The propel-

lers are suitably spaced along the shaft within the tube 1, so as to produce the maximum thrust upon the propellers and in turn upon the vessel.

5 A man-hole is provided in the tube 1 and is preferably located so as to permit easy access to the propellers and entrance into the tube. It is closed by a cover 1^a.

The propeller shaft 3 may be made in sections, if desired. The sections are connected in the best embodiment of the invention by the coupling shown in Fig. 3. In this figure the shaft coupling is located adjacent to one of the propellers. The portion 3^a of the shaft carries one part of a coupling 4, the coupling being secured to the shaft 3^a by a key 5. Coupling pins 6, which enter holes in the coupling 4, are provided with heads 7 to engage recesses in the hub 8 of the propeller 2. The propeller is secured to the shaft 3^b by a suitable key 9. By means of this coupling a flexible connection is made between the parts of the shaft. This coupling prevents the shaft from binding in the bearings if the parts are sprung out of alinement. It will be observed that the structure of the propelling mechanism near the propeller is necessarily weaker than the rest of the tube and its connections, the parts being here cut away. By locating the coupling near the propeller any tendency produced, for example by the motion of the boat, to distort or throw the shaft out of alinement while the boat is under way, is accommodated and avoided by the flexible coupling.

Suitable means are provided to prevent the swirl of the water in the tube in which the propellers are mounted. In the best embodiment of the invention I make use of partition plates 10 located adjacent to the propellers. In the preferred form of the invention, the partition plates extend aft of each propeller for a distance corresponding substantially to at least half of the pitch of the propeller. This prevents swirling of the water without introducing undue frictional opposition to the passage of the water through the tube. In the best embodiment of my invention the partition plates provide a means for supporting the propeller shaft and rigidly mounting it within the tube. In the drawings the plates 10 are secured to the tube 1 by means of angle irons 11. These angle irons preferably extend between the partition plates so as to strengthen the structure.

One or more bearing tubes 12 are secured to the partition plates 10. The preferred means of securing the tubes to the plates are the means shown more clearly in Fig. 4. The plates are enlarged at 10^a so as to embrace the tube 12. Shaft bearings 13 are mounted at intervals within the tubes 12. These bearings are made flush with the bear-

ing tubes 12 so as to avoid obstructing the flow of water through the water way.

In the best embodiment of my invention I provide means for resisting the thrust of the propellers and for transmitting it to the propeller tube and hull of the vessel. A plurality of thrust bearings 14 are located in front of each propeller so as to take the thrust when the vessel is going forward. In the best embodiment of my invention the bearings are constructed as shown in Figs. 3 and 5.

An anti-friction device such as a plurality of conical rollers 15, each mounted on its stud in the ring 16, is interposed between the bearing 13 and the thrust collar or block 17. These thrust bearings are located adjacent to the propellers so that the thrust of the propeller is directly transmitted through the thrust collars, anti-friction bearings and shaft bearings to the partition plates, propeller tube and hull of the vessel. I also arrange a thrust bearing to be used in backing, aft of one or more propellers. The corresponding parts of these backing bearings are lettered 14^a, 15^a, 16^a, 17^a.

Suitable means are provided for driving the propeller shaft at one or more points. In the best embodiment of my invention I provide a gear wheel for driving the shaft which is constructed and arranged so as not to obstruct the passage of the water through the water way. The driving gear wheel 18 is such a gear wheel. The arms of the gear wheel 18 are made in the shape of propeller blades. They preferably produce a thrust against the water in the water way, and their length is at least equal to that of the other propeller blades. In the best embodiment of my invention I locate the rim of the gear wheel 18 within a suitable recess. The inside diameter of the rim is substantially equal to that of the water way. This recess is preferably formed by a casing 19^a secured to the tube 1 by any desired means. I have shown angle irons 20 as one means of securing the casing to the tube. In the form of the invention illustrated upon the drawings, the recess incloses the face and sides of the rim of the gear wheel so that the rim of the gear wheel does not obstruct the tube.

Suitable means are provided for driving the gear wheel. In the best embodiment of my invention I equalize the driving effort for driving the propeller shaft by means of a plurality of driving trains.

Compound engines 21 and 22 are located in the hull of the vessel on opposite sides of the propeller tube. Shafts 23 and 24 passing through stuffing boxes 25 and 26 are each provided with a gear 27 and 28. These gears engage preferably with the gear wheel 18 at or near opposite sides of the

gear wheel. A water tight casing is provided for the driving mechanism. In the embodiment of the invention illustrated in the drawings, the plates 29 and 30 form the side walls of the casing and the plate 31 secured to the side walls 29 and 30 by angle irons 32, 32¹ forms the cover. The bottom of the casing consists of the plate 33 which is rigidly secured to the intercostal plates 34 by means of the angle bar 34¹. Angle irons 35, 36, 37, 38, 39 and 40 firmly secure the casing to the longitudinal plates 41 and 42 constituting part of the inner bottom plates of the double bottom of the vessel. These plates are in turn rigidly connected with the thwartship frames forming part of the construction of the hull. Splash plates 40^a and 40^b partially surround the gear wheel 18 and are secured to the side walls 29 and 30 of the casing by angle irons 40^c and 40^d. These splash plates prevent the water from splashing the gears 27 and 28.

Suitable means are provided for closing the tube when it is desired to repair or examine the propelling mechanism. In the best embodiment of the invention, this means consists of a plurality of gates which are so mounted in the tube as not to weaken its construction and so that the gates may act as valves and also serve the purpose of partition plates to prevent the swirl of the water in the tube. With this object in view, I provide a gate 43 at each end of the tube. The gate is mounted upon a shaft and suitable means such as a worm wheel 44 and hand wheel 45 are provided for rotating the gate. When the gate extends lengthwise of the tube it operates like the plates 10, to prevent the swirling of the water.

As a means for steering the vessel I provide, in the best embodiment of my invention, a rudder 46 with a portion 47 extending within the tube. The rudder is mounted on a post 48. The portion 47 conforms in shape to the cross-section of the tube and in the form of the invention illustrated upon the drawings, the portion 47 has a curved front edge so as to approximately fit the tube when the rudder is deflected. By this means the front edge deflects the stream of water as it issues from the tube and increases the effectiveness of the steering. Another rudder 49 on a post 50 is arranged aft of the rudder 46 so as to cooperate with it if desired in the steering action; to secure this cooperation the post 48 and the post 50 are provided with means for causing them to move in unison such as a segment at the upper end of each post and a flexible connecting device.

Suitable means are provided at the mouth of the propeller tube for preventing the entry of foreign objects within the tube. In accordance with my invention this means is so constructed as to offer great resistance to

deformation if it should strike an obstruction. As illustrated in the drawings, the guard comprises a central backbone 51 inclined in a vertical plane. To this is connected at one end the straight ribs 52 formed of flat bars, having their other ends connected to the tube and hull—the thin edges of the ribs cutting the water as the vessel moves through it. The bodies of the ribs are arranged in planes parallel to the direction of movement of the vessel. In the particular embodiment of the invention illustrated in the drawings the tube is cut away at an angle, the lower wall being shortened, the central rib lying in a vertical plane and the side ribs in horizontal planes. By this means a construction is afforded which offers the maximum of strength with the minimum of resistance to its passage through the water.

In accordance with my invention I so construct and arrange the propeller tube and its appurtenances that it constitutes an integral part of the keelson of the vessel. By this means I not only do away with a structure hitherto considered extremely necessary in large vessels, viz., the keelson structure, but I also utilize the propeller tube to the best advantage so as to itself constitute a part of the keelson and strengthen the hull in a longitudinal direction. In accordance with my invention, therefore, not only does the propeller tube avoid weakening the construction of the hull but it materially strengthens it.

In the best embodiment of the invention the propeller tube, the interior of which is suitably braced as heretofore described, is rigidly connected to the thwartship frames of the hull. The construction and arrangement of the thwartship frames may be widely varied. In the best embodiment of the invention, thwartship plates are secured to the shell plating of the hull and the propeller tube is rigidly connected to these plates by suitable connections.

Referring now more particularly to Figs. 1 and 7 of the drawings, one means of securing the propeller tube to the plates in accordance with my invention is illustrated. In the vessel illustrated in the drawings a series of frames 53 and 54 is provided to maintain the shape of the vessel and to strengthen it thwartship. The shell plates 55 are secured to the frames. The web frames 53 consist of web frame plates 56 to which the shell plates 55 are secured by means of the angle bar frames 57. Face angle bars 58 are provided to complete the web frames, these bars are connected to the plates 56. Stringer plates 59 are connected to the face bars 58 in the usual manner. As shown in the drawings, I have connected the propeller tube with the thwartship floor plates. These plates com-

prise intercostal plates 60 secured to the angle bar frames 57. Angle bars 61 complete the floor plate frames and afford a support for the inner bottom 41 and 42 of the double bottom construction. In the best embodiment of my invention when using an inner bottom I rigidly secure the propeller tube to the inner bottom. The means for accomplishing this result may be varied. I prefer to provide brackets 63 stiffened by a rib 64 for connecting the propeller tube to the inner bottom. Angle irons 65 secure the brackets 63 to the inner bottom and angle irons 66 secure the tube to the brackets. The tube coöperates with the inner bottom to complete it and assist in making the inner bottom water tight.

The formation of the frames and tube near the bow of the vessel is shown in Fig. 8. The numerals in this figure indicate the same parts that are illustrated in the other figures. The thwartship frames of the vessel are rigidly connected together by means of the stringer plates 59 and the longitudinal plates 67. The plates 67 are secured to the shell plating of the vessel by angle irons 68. The tube is secured to the plates 67 by angle irons 69. Angle clips 70 are used to connect the longitudinal plates to the thwartship plates 60.

By the above means a rigid keelson construction is secured in the propeller tube forming an integral part of the keelson.

In the form of my invention illustrated in Fig. 9, I make use of a plurality of propeller tubes. In this figure the same parts are used as in the apparatus illustrated in the other figures of the drawings. The inner bottom is shown at 41 and 42. Each tube is provided with a rudder extending into the tube. The propeller tubes form the main constituents of the keelson. Floor plates 71 are secured to the shell of the vessel by means of angle bars 72. Longitudinal plates 73 are secured to the shell plates by angle irons 74. The propeller tubes are connected to the inner bottom and floor plates by stiffened brackets 76. Angle irons 77 secure the tubes to the brackets. Angle irons 78 secure the brackets to the floor plates and inner bottom. Angle irons 79 secure a dividing bulkhead 80 to the center line keelson 81. This bulkhead offers a means of separating the propeller tubes, engines, etc., from each other and divides the vessel into longitudinal compartments. Angle irons 82 are provided to stiffen the bulkhead.

My invention, in its broader aspects, is not limited to the particular construction shown, as many changes other than those herein suggested may be made in such construction without departing from the principles of my invention and without sacrificing its chief advantages. Nor is my in-

vention limited to any particular theory or mode of action.

What I claim as new and desire to secure by Letters Patent, is:—

1. In an apparatus for propelling vessels the combination of a tube of uniform, circular cross-section from end to end, fixed to the hull parallel to the keelson, a propelling shaft extending from end to end of said tube supported at the axis thereof, concentric tube sections, means for supporting each tube section within the main tube and bearings for said shaft, one within each tube section.

2. In a means for propelling vessels, the combination of a main tube of uniform, circular cross-section fixed to the hull parallel with the keelson, a propelling shaft extending from end to end of the tube and supported at the axis thereof, a plurality of propeller wheels each substantially equal in diameter to the diameter of said tube, concentric tube sections supported upon the interior wall of the main tube, a series of bearings for said shaft, one in the end of each tube section adjacent to each propeller wheel and means for driving said shaft located in the hull.

3. In a means for propelling vessels the combination of a tube of uniform, circular cross-section fixed to the hull parallel with the keelson and extending substantially from one end of the keelson to the other, a propelling shaft extending from end to end of the tube, concentric tube sections supported at diametrically opposite points on the interior of the main tube wall, bearings for said shaft, one within each tube section, a plurality of propelling wheels fixed to said shaft and means for driving said shaft.

4. In a means for propelling vessels the combination of a tube of uniform, circular cross section fixed to the hull parallel to the keelson, a sectional propelling shaft extending from end to end of the tube, means for supporting said shaft located at intervals on the interior of said tube, comprising concentric tube sections fixed in position, a series of propelling wheels fixed to said shaft, means for preventing the swirl of water in the tube consisting of plates fixed in position in a fore and aft line, each extending a distance at least equal to half the pitch of the adjacent propeller and means for driving said shaft located in the hull.

5. In a means for propelling vessels, the combination of a tube of substantially uniform, circular cross-section fixed to the hull parallel with the keelson, a propelling shaft extending from end to end of the tube and supported at the axis thereof, a series of propelling wheels fixed to said shaft each substantially equal in diameter to the diameter of said tube, a concentric tube section,

means for supporting said section within the main tube and bearings for said shaft within said tube section.

6. In a vessel the combination of a suitable hull, a tube of uniform, circular cross section fixed on the interior of the hull, concentric tube sections fixed in position within said first tube, a propelling shaft consisting of a series of jointed sections central within said tube sections, bearings for said shaft sections, one in the end of each tube section, a series of propelling wheels one fixed in close proximity to each joint of said shaft, and a source of motive power located in the hull and connected with said shaft.

7. In a means for propelling vessels, the combination of a tube of substantially uniform, circular cross-section fixed to the hull, a keelson parallel with the major axis of said tube, a propelling shaft extending from end to end of the tube, a series of bearings for said shaft and means for connecting said bearings with the interior of said tube consisting of a sectional concentric tube and plates uniting said tube sections with the main tube.

8. A vessel comprising in combination a hull, a tube of uniform, circular cross section from end to end, means for connecting said tube with said hull in a line parallel with the keelson, a plurality of propelling devices located in said tube, a rudder in position at the rear of the terminal of said tube but separated therefrom, and a rudder located partly within said tube.

9. A vessel, comprising in combination a hull, a tube of substantially uniform, circular cross-section extending longitudinally thereof, means for propelling said vessel located in the tube and a plurality of rudders, one extending within the tube, a second located aft of the first named rudder and means for causing said rudders to cooperate.

10. In a vessel, the combination with the hull, of a removable tube located within said hull, said tube extending longitudinally of the vessel, plates arranged thwartship, angle bars for securing said plates to the shell of the hull, means for securing said tube to said plates and means comprising a series of spaced propellers located within said tube for propelling said vessel.

11. In a vessel, the combination with the hull, of a removable tube located within said hull, said tube extending longitudinally of the vessel, plates arranged thwartship, angle bars for securing said plates to the shell of the hull, brackets, means for connecting said brackets to said plates, angle bars for securing said brackets to said tube, and means located within said tube for propelling said vessel.

12. In a means for propelling vessels, the combination with the hull of a tube of sub-

stantially uniform, circular cross-section fixed in position in said hull parallel with the keelson, the forward end of said tube being cut away at an acute angle, a propelling shaft consisting of articulated sections extending from end to end of said tube, a concentric tube section for each section of the shaft, thrust bearings connecting said shaft with said tube sections, a series of plates parallel with the axis of the tube connecting the tube sections with the main tube, propeller wheels fixed on said shaft, one for each pair of tube sections, means for driving said shaft, and an inlet guard located within the opening in the tube.

13. In a means for propelling vessels, the combination with the hull of a tube of substantially uniform, circular cross-section fixed in position in said hull parallel with the keelson, the forward end of said tube being cut away at an acute angle with the axis thereof, a propelling shaft consisting of articulated sections extending from end to end of said tube, concentric tube sections of smaller diameter for each shaft section, thrust bearings connecting said shaft with said tube sections, a series of plates arranged in fore and aft planes connecting the tube sections with the main tube, propelling wheels fixed on said shaft at the junction of the tube sections, means for driving said shaft and an inlet guard within the forward opening in the tube consisting of a plate or strip fixed in the plane of the axis of the tube, and two series of plates or strips having their ends fixed to the interior wall of the tube and their opposite ends converging on the first named plane or strip.

14. In a vessel the combination of a hull, a tube of substantially, uniform, circular cross-section extending longitudinally thereof, a rudder at the rear end of said tube located outside said tube extending within said tube and provided with a curved edge approximately fitting the curvature of the tube when the rudder is deflected and a second rudder located on the hull at the rear of the first named rudder, said second rudder being mechanically connected to move in unison with the first rudder.

15. A vessel, comprising in combination, a hull, a tube extending longitudinally thereof, partition plates located within the tube and secured thereto, said plates being suitably curved at their middle portions, a tube supported within the curved portions of said plates, bearings supported by the tube, a shaft extending through said bearings and a series of propellers carried on the shaft.

16. In a vessel the combination of a hull, a tube of substantially uniform, circular cross-section fixed in position parallel with the keelson, a series of propelling wheels within said tube, a jointed shaft for driving said wheels, dividing plates fixed in the tube lon-

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gitudinally and a rudder having a curved front edge entering said tube.

17. In a vessel, the combination of a hull, a tube extending longitudinally thereof, a series of dividing partitions extending longitudinally of the tube and formed with central hollow enlargements, a tube supported within the hollow spaces of said enlargements, bearings supported by the tube and a propeller shaft supported in the bearings.

18. In a vessel, the combination of a hull, a tube extending longitudinally thereof, dividing plates located within the tube and formed with central hollow enlargements, a tube supported within the hollow spaces of said enlargements, thrust bearings supported by the tube, a shaft extending through the thrust bearings, and a series of propellers carried on the shaft.

19. In a vessel, the combination of a hull, having a tube or channel, a driving means, a shaft supported in the tube, a plurality of propellers suitably spaced on said shaft, a tubular member surrounding said shaft and having bearings flush with the tubular member within the tube, whereby the resistance to the flow of water will be lessened, and rotary gates serving the function of dividing plates, and also serving as valves.

20. In a vessel, the combination of a hull, a tube extending longitudinally thereof, dividing plates in said tube, a shaft supported by said dividing plates, propellers carried by said shaft, a plurality of thrust blocks surrounding said shaft and located adjacent to individual propellers, and a roller bearing intervening between the thrust blocks.

21. In a vessel, the combination of a tube, dividing plates therein, a shaft carrying propellers and supported by the dividing plates, a thrust-block surrounding the shaft and bearing against a dividing plate, another block also surrounding the shaft and adapted to receive the thrust of a propeller, and a roller bearing intervening between the blocks.

22. In a vessel, the combination of a hull, a tube extending longitudinally thereof, dividing plates in said tube, a shaft supported by said dividing plates, a driving wheel on said shaft and an annular recess offset from the said tube receiving the rim of said wheel, said recess inclosing the face and both edges of the rim of said wheel, whereby the rim of the wheel does not obstruct the tube.

23. In a vessel, the combination of a hull, a tube carried thereby and extending longitudinally thereof, said tube having an annular recess, the said tube being provided with a shaft having propellers for propelling the vessel, a driving wheel located

in the tube and having its rim located in said annular recess of the tube, so as to allow an unobstructed passage of the water and a driving gear engaging the gear wheel in the tube.

24. In a vessel, the combination of a hull having a tube or channel, cut away in front to present curved edges, a guard comprising an inclined straight central backbone, straight ribs extending substantially horizontally from the curved edges to the backbone, and converging in a forward direction, and dividing plates, thereby preventing the swirl of water.

25. In a vessel the combination of a hull, a tube fixed to the hull in a line parallel with the keelson, said tube having its forward end cut away at an acute angle, a plurality of propellers located within said tube, an inlet guard located within the opening in the forward end of said tube, said guard comprising an inclined, central backbone and straight ribs extending from the inner wall of the tube to the backbone converging toward the end of the tube.

26. In a vessel, the combination of a hull, a tube fixed to the hull in a line parallel with the keelson, said tube having its forward end cut away at an angle, propellers located in said tube, an inlet guard located within the opening in the forward end of the tube, said guard comprising thin, flat strips or plates presenting their edges to cut the water in the forward movement of the vessel.

27. In a vessel the combination with the hull of a tube fixed to the hull in a line parallel with the keelson, said tube having its forward end cut away at an angle, a propeller in said tube, an inlet guard located within the opening in the forward end of said tube, said guard comprising an inclined, central strip or plate and two series of flat plates or strips extending from the inner wall and converging at said central strip.

28. In a vessel, the combination of a hull, a tube, a plurality of propellers in said tube, one of said propellers comprising a driving wheel, the arms of which form propeller blades, said tube being provided with an annular recess, in which the rim of said propeller wheel is located.

29. In a vessel the combination with the hull of a tube fixed to the hull parallel with the keelson, a propelling shaft within said tube composed of a series of articulated sections, a plurality of propeller wheels, one on each shaft section, a plurality of separate engines for driving said shaft, connected to said shaft through a single unitary connection on said shaft, and anti-friction thrust bearings for each section of said shaft, said bearings being located on opposite sides of

the propeller to provide for movement in either direction.

30. In a vessel, the combination with the hull of a tube fixed to the hull parallel with the keelson, a sectional shaft within said tube, sections of tube surrounding the shaft and fixed to the interior wall of the main tube, a series of propellers fixed to the shaft at successive distances adapted to avoid cavitation, thrust bearings between said shaft sections fore and aft of each propeller and means for driving the shaft.

31. In a vessel, the combination of a hull, two tubes of substantially uniform, circular cross-section within said hull upon opposite sides of the keelson and parallel therewith, thwartship plates for securing said tubes within said hull, a driving shaft consisting of articulated sections for each tube extending from end to end thereof, a plurality of propellers within each tube, one for each driving shaft section, and means for driving said shafts.

32. In a vessel, the combination of a hull, a plurality of tubes within said hull, a longitudinal bulkhead between the tubes, a plurality of propellers within each tube, and means for securing said tubes and said bulkhead to said hull.

33. In a vessel the combination with the hull, of an inner bottom therefor, a tube of substantially uniform, circular cross-section fixed to said inner bottom parallel with the keelson, a plurality of propellers in said tube, a driving shaft extending from end to

end of the tube on which said propellers are fixed, and means for driving said shaft.

34. In a vessel the combination with the hull of an inner bottom therefor, a tube of substantially uniform, circular cross-section located on said inner bottom parallel with the keelson, thwartship plates connecting said tube to said inner bottom, a plurality of propellers in said tube, a propelling shaft extending from end to end of the tube concentric therewith and means for driving said shaft.

35. In a vessel the combination with the hull of a plurality of tubes of substantially uniform, circular cross-section, an inner bottom for said hull upon which said tubes are located, thwartship plates for connecting said tubes to said inner bottom, a plurality of propellers in each tube, a concentric shaft in each tube extending from end to end thereof and means for driving said shaft.

36. In a vessel, the combination of a hull, a plurality of tubes, a plurality of propellers in each tube, thwartship plates, an inner bottom, and a longitudinal bulkhead between adjacent tubes, and means for securing said parts together.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

THOMAS B. TAYLOR.

Witnesses:

WILLIAM F. BISSING,
EDWIN SEGER.