H. A. DUC, Jr.

APPARATUS FOR PROPELLING VESSELS BY HYDRAULIC PRESSURE.

APPLICATION FILED APR. 4, 1906.

958,996.

Patented May 24, 1910.

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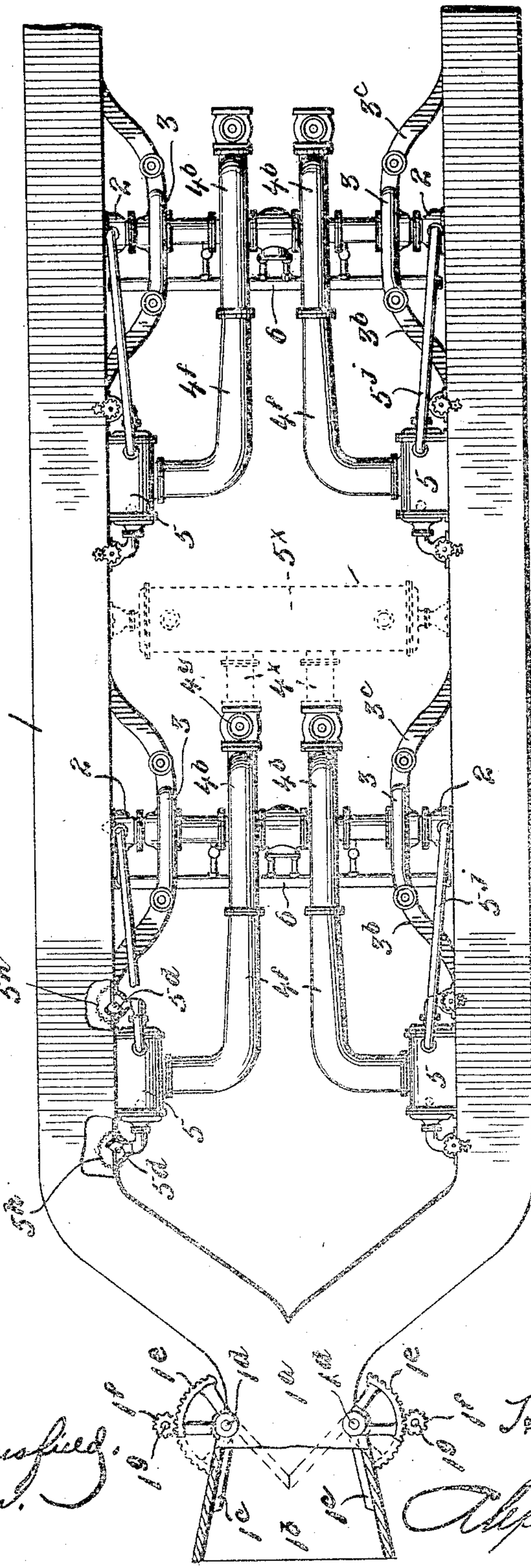

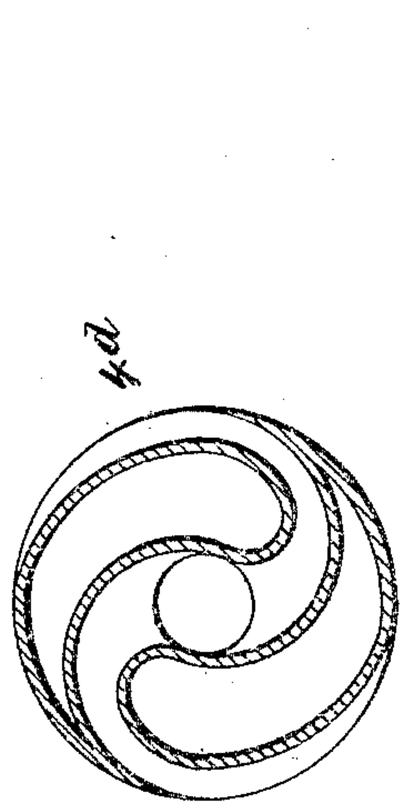

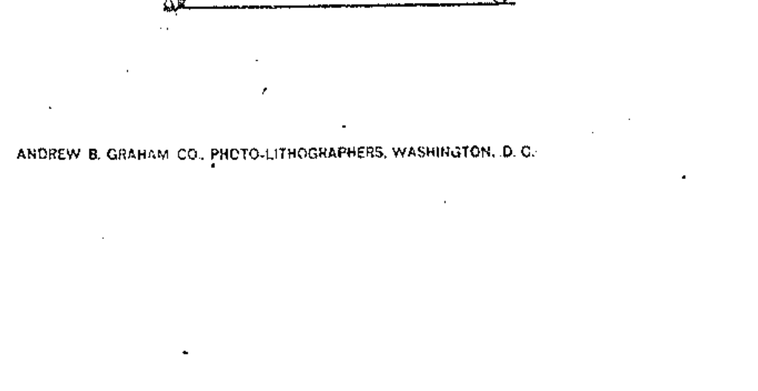

WITNESSES:

James F. Mansfield.

L. E. Oakham.

INVENTOR

Henry A. Duc, Jr.

Alexander Sprole

Attorney.

H. A. DUC, Jr.

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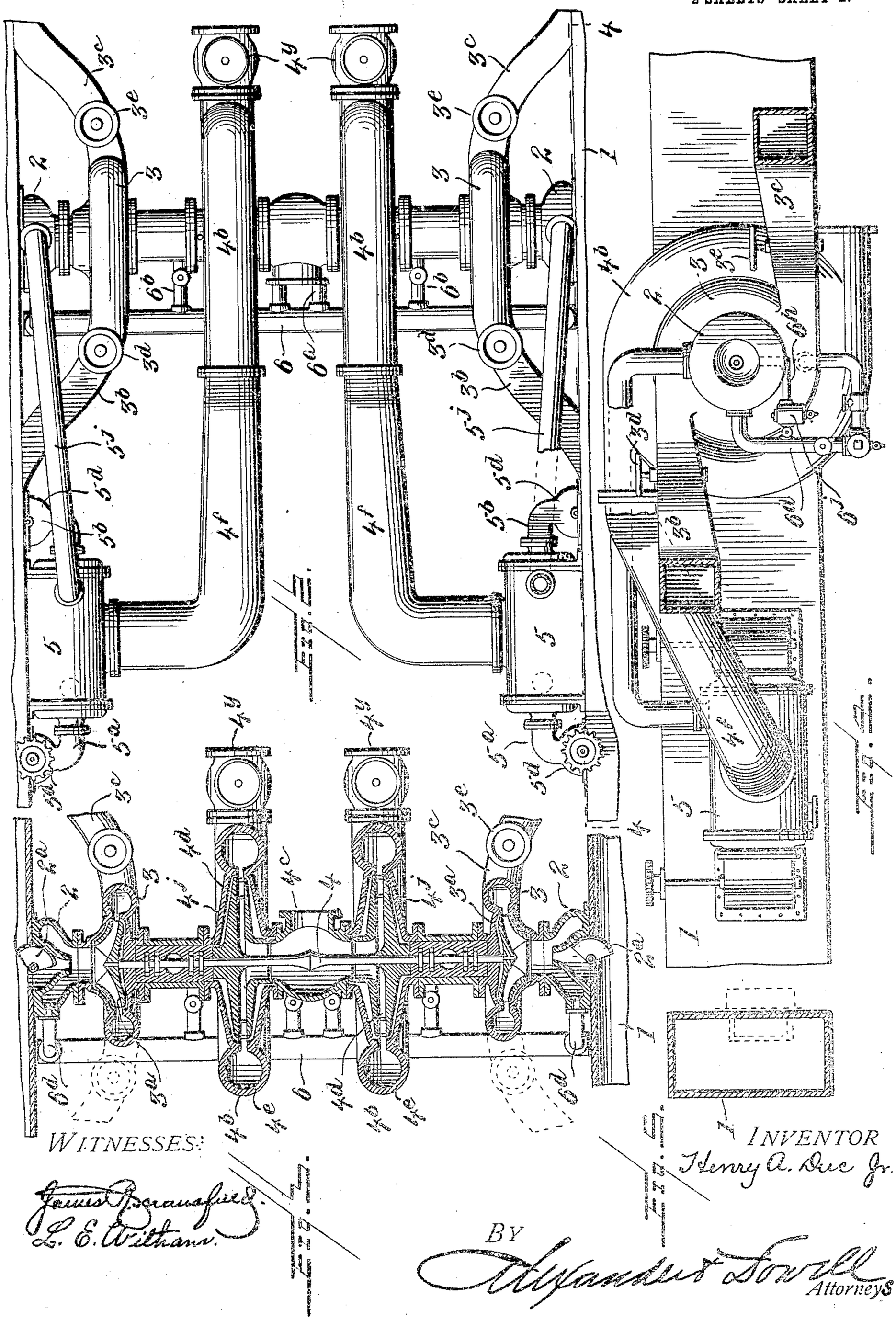

WITNESSES:

James P. Brownfield.

L. E. Withans.

INVENTOR

Henry A. Duc Jr.

BY

Alexander & Sawall

Attorneys

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

HENRY A. DUC, JR., OF CHARLESTON, SOUTH CAROLINA.

APPARATUS FOR PROPELLING VESSELS BY HYDRAULIC PRESSURE.

958,996. Specification of Letters Patent. **Patented May 24, 1910.**

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To all whom it may concern:

Be it known that I, HENRY A. DUC, Jr., of Charleston, in the county of Charleston and State of South Carolina, have invented certain new and useful Improvements in Apparatus for Propelling Vessels by Hydraulic Pressure; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improved apparatus for propelling vessels by hydraulic pressure or currents of water ejected from the vessel with great pressure.

The invention comprises a novel arrangement and construction of rotary turbine actuated pumps for imparting pressure to the currents of water and driving the same with increased power or velocity toward the exit of the channels.

It also includes novel means for utilizing the water currents to cool the condensers; also includes novel construction and means whereby the water currents are utilized to produce high vacuums in the condensers and to remove skin friction from the turbines, and waste and leakage in the bearings of the engine-shaft.

It further includes a novel construction of parts whereby the water currents may be propelled either forward or backward without necessitating reversing the actuating turbines or pumps.

The invention therefore consists in the novel construction and combination of the apparatus as a whole, and of subsidiary parts thereof, as hereinafter set forth in the claims, and whose nature and scope will be readily comprehended from the following description of the apparatus illustrated in the drawings, which apparatus embodies one form of the invention, but I do not consider myself restricted to the particular construction and arrangement of parts illustrated in the drawings, as these can and must be somewhat varied in order to suit the apparatus to vessels of different size and construction.

In the said drawings—Figure 1 is a diagrammatical plan view of a complete apparatus for propulsion ot vessels, removed from the vessel. Fig. 2 is an enlargeo detail plan view of one set of engines, pumps and condensers. Fig. 3 is a horizontal sectional view through a set of pumps and engines. Fig. 4 is a vertical sectional view on line 4—4, Fig. 2. Fig. 5 is a sectional view of one of the water channels or conduits. Fig. 6 is a detail sectional view of one of the reaction turbine wheels.

As shown in Fig. 1 there are two main water channels or conduits 1, 1, which are to extend longitudinally of the vessel on opposite sides of the median line thereof,— these conduits open at each end into the water, so as to freely take in and freely discharge water; they may have separate inlets and outlets if preferred, as indicated at the right hand end of Fig. 1, but I prefer to have them converge at their ends and coincide in a common head 1^a which forms the intake or outlet, and preferably has a flaring or fish-tail mouth 1^b and is of sufficient cross sectional area to provide for free entrance and exit of the water to and from each conduit. The head 1^a may be provided with swinging valves 1^c attached to vertical shafts 1^d provided with segments 1^e meshing with pinions 1^f on shafts 1^g which can extend upward and be operated by hand or suitable mechanism, not shown, so as to open or close, or adjust the valves 1^c to any desired position. When closed as indicated in Fig. 1, the valves prevent entrance of water, and may be used to regulate the inflow and speed of propulsion without stopping any of the pumps, and a second set of hinged gratings may be used to keep out marine animals, trash, etc., into the channels when vessel is docked. These valves are also useful for steering purposes as by properly manipulating them the outflowing current of water can be diverted to right or left so as to turn the vessel after the manner of a rudder.

The conduits 1 are preferably rectangular in cross section, as in Fig. 5, but this is not an essential feature. The conduits communicate at opposite points through suitable openings with jet-heads 2, through which the water passes into turbine pumps 3, the pistons 3^a wherein are mounted on opposite ends of a shaft 4, which also forms the main shaft of a pair of turbine engines 4^b, which are in axial alinement with the pumps 3 and the jet-heads 2. Each turbine 4^b communicates with a common inlet chamber 4^c, into which steam is admitted from any suitable generator, not shown, and said turbines are preferably of the reaction type, having reaction pistons 4^d, as indicated in Fig. 6,

which discharge the steam into surrounding annular chambers 4^e from which the exhaust steam is conducted through pipes 4^f to the condensers 5 as indicated in the drawings.

It will be observed that the inlets of the pistons of the adjacent turbines 4^b are set oppositely on shaft 4, so that these pistons counterbalance lateral thrust. It will also be seen that the opposite pump pistons 3^a will counterbalance each other, consequently there is no longitudinal thrust on the shaft 4 in its bearings and no loss of power by the friction ordinarily engendered in such engines by the lateral thrust of collars on the shaft in its bearings.

Each pump 3 has diametrically opposite tangential outlets which communicate with oppositely extending pipes 3^b, 3^c, provided with valves 3^d, 3^e, of any suitable construction so that when one pipe is in use the other may be closed. These pipes 3^b, 3^c, extend in opposite directions and communicate with the adjacent conduit 1 respectively in advance of and in rear of the jet-head 2 leading to the pump, as shown in the drawings. By opening the proper pipe 3^b or 3^c, the water discharged from the pump can be injected into the conduit either toward the stern or bow of the boat as may be desired, without having to reverse the direction of rotation of the turbines or pumps.

The water will be drawn from the conduits through the jet-heads by the natural suction of the pumps, and will be forcibly returned into the conduit through pipe 3^b or 3^c. In order to direct the water into the jet-head and assist the operation of the pumps, deflector valves may be used, as indicated at 2^a in Fig. 3, which deflector valves are concaved, and can be turned to right or left so as to catch the part of the current of water flowing through the conduit and direct it through the jet-head to the pump. These deflector valves 2^a may be used to shut off the water entirely, and may be operated by any suitable means, gearing being indicated in the drawings for that purpose.

The condensers 5 may be cooled by the water flowing through the conduits 1, and for this purpose are preferably located as shown in Figs. 1 and 2, parallel with and beside the conduits, and connect at opposite ends with the conduits by pipes 5^a, 5^b, which may be provided with deflector valves 5^d, similar to deflectors 2^a, so as to direct the water naturally into and through the condensers, which deflector valves can be operated by any suitable means. Screens 5^h may be placed over the inlets to pipes 5^a, 5^b, to prevent debris and marine animals getting into and clogging the condenser tubes and water passages. The particular internal construction of the condensers is not claimed herein, being well known. In order to create a partial vacuum in the condensers, they can be exhausted by means of pipes 5^j, connecting the condensers with the adjacent jet-heads 2, in such manner that the inflow of water through these jet-heads creates a suction in pipes 5^j and thus continually exhausts the condenser.

To relieve skin friction in the turbines, the chambers 4^j of the turbines at the inactive sides of the pistons are connected by pipes 6^a to a header pipe 6, and the casing of shaft 4 may be similarly connected by pipes 6^b to said header, which is connected at its ends by pipes 6^d to the jet-heads 2, in such manner that the inflowing jet of water creates a suction in the header and thus exhausts the pressure which might otherwise accumulate at the inactive sides of the chambers and around the shaft, and thus relieves the skin friction or back pressure which acts as a brake and causes loss of power in such engines. The oil and leakage seeping through the bearings may be conducted off through a pipe 6^h provided with an oil trap 6^j as indicated in the drawings.

If desired a large condenser could be arranged intermediate and between the conduits 1, as indicated in dotted lines at 5^x in the drawings, the water being circulated therethrough from one conduit to the other, and the exhaust from the engines discharging thereinto through outlets 4^x, which can be closed when such condenser is not in use by valves 4^y, and these valves may have independent pipes opening into the atmosphere when it is necessary. Ordinarily when condensers 5 are used, condensers 5^x may be dispensed with, and vice versa.

By the described arrangement of parts I am enabled to operate the turbine engines at very high speed with very low pressure steam, preferably employing reaction engines which operate economically at low pressure. By the provision of duplicate oppositely arranged outlet pipes for each pump, it is obvious that the pumps do not have to be reversed in order to reverse the flow of water in the conduits.

It will be noted that I do not pass all the water in the conduits through pumps, this I do not desire to do, but instead I withdraw a portion of the volume of water from the conduits, impart a high velocity or pressure thereto and return it into the conduit wherein it puts the entire body of water in the conduit into motion with a high pressure but low speed proportional to their mass weights, so that when it emerges from the vessel it will act most powerfully to propel the vessel, because I have found that a large body of water moving at a comparatively slow speed, is much more effective for propulsion purposes than a small body of water moving at a higher speed, for the reason that a small stream of water driven with high velocity into a body of water will pene-

trate into such body of water and the greater part of its force is dissipated without reactive effect, the propulsive effect of a hydraulic-jet increasing in proportion as the speed of its reaction approaches its issuing velocity.

By utilizing the water flowing through the conduits to cool the condensers I am enabled to dispense with auxiliary pumps for the condensers; and by utilizing the jet of water entering the pumps to create suction in the condensers and to remove skin friction from the engines I obtain a further increased efficiency of operation of the apparatus and obviate a great deal of machinery usually employed in connection with the engine and condensers.

As many channels arranged with any number of pumps can be used independently or connected, so that the reactive propulsion may be all in one direction or opposedly used when desired to reduce the headway or produce lateral thrust in opposite directions for quickly turning the vessel without stopping the pumps, and by stopping some of the pumps the speed may be slowed down, or by running more the speed can be increased and all of the pumps may be operated at one time to impart their combined energy to the propelling water in any one direction and keep up the propulsive effect, in rough weather without any danger from engines racing.

Other types of turbines or rotary engines may be used to drive the pumps and get the benefit of removing the brake-action, oil-waste, journal-leakage, and exhaust the condenser, by the induction-jet connected to the pumps, and provided with rotatable guiding valves to cause the propelling water to flow into the pumps, and through the condenser tubes, while moving forward in all of the channels, or forward in some and backward in the others, and still be within the present invention.

The system shown herein has many valuable features which may be varied to suit, such as forming the surface condensers as a part of the propelling water channels, so that there will be no lifting of the water flowing through the condenser tubes and only the small amount of power required to overcome its friction can be absorbed, no passing through circulating pump valves and such like energy consuming combinations.

The pumps are made comparatively small and the small amount of water passing therethrough with a high speed does not lose as much energy as when the whole amount of propelling water has to pass through pumps large enough to handle the whole of the propelling water.

The advantages which are gained by the novel combination shown in the present invention, *i. e.* the utilization of low pressure steam to produce a high speed water-current rushing through an induction-jet to produce and maintain a vacuum (as high as the limit of any turbine pump, say 30 feet or thereabout,) throughout the condenser, shaft-housing and wheel-chambers, to remove the skin-friction and prevent the lubricating oil, steam and water leakage from around the shaft from mingling with the feed water, are apparent to those who operate such engines, and the mechanical construction, made possible by these useful combinations which annihilate endwise thrust on collared shafts, together with the absence of all stuffing boxes, cost of packing, labor and the care needed to keep them absolutely tight, which turbines, unlike piston engines, uncomprisingly require, otherwise the skin friction is not removed and the efficiency for pounds of coal is diminished, must win the approbation of the engine driver, and tend to more fully satisfy the demands of the modern engineer, *i. e.* away with all unnecessary thrust and means to receive such by perfectly absorbing the reaction of any mass displacement and reconvert it into useful energy.

Having described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In combination, a water channel leading through a vessel, and a pump and intake and return-pipes adapted to continuously withdraw a part of the water from the channel and inject it thereinto under pressure, substantially as described.

2. In combination with a water conduit leading through a vessel; of a rotary pump and intake and return-pipes adapted to continuously withdraw a part of the water from the channel, impart a high velocity and pressure thereto, and return it into the channel, substantially as described.

3. In an apparatus for propelling vessels by hydraulic power, a water channel leading through the vessel, a rotary pump communicating with said channel and adapted to withdraw a part of the water therefrom, impart a high velocity or pressure thereto, and means for directing the water from the pump into the channel in advance of or in rear of the intake of the pump at will.

4. In combination with a water conduit leading through a vessel, a pump, an inlet from the channel into the pump, return pipes leading from the pump casing into the channel at opposite sides of the intake of the pump, said pump adapted to withdraw water from the channel and return it thereinto at a higher velocity, and means for closing either return pipe.

5. In combination with a water conduit leading through a vessel, a rotary pump, an inlet from the channel into the pump, return pipes leading from the pump casing

into the channel at opposite sides of the intake of the pump, said pump adapted to withdraw water from the channel and return it thereinto at a higher velocity, means for rotating the pump continuously in one direction, and means for closing either return pipe.

6. In combination with a water conduit, a pump having an intake from the channel, a rotary engine connected with said pump, a condenser traversed by water flowing through the conduit, and means for returning the water from the pump into the channel, substantially as described.

7. In combination with a water conduit leading through a vessel, a rotary pump having an intake from the channel, a turbine engine connected with said pump, a condenser traversed by water flowing through the conduit, and means for returning the water from the pump into the channel, either fore or aft of the intake, substantially as described.

8. In combination with a water conduit, a pump having its intake connected with said channel, a rotary engine connected with said pump, a condenser, an exhaust pipe connecting the engine with said condenser, a suction pipe connecting the condenser with the intake of the pump, and means for conducting the water from said pump back into the conduit.

9. In combination with a water conduit leading through a vessel, a rotary pump having its intake connected with said channel, a turbine engine connected with said pump, a condenser connected with said conduit so as to be cooled by water flowing therethrough, an exhaust pipe connecting the engine with said condenser, a suction pipe connecting the condenser with the intake of the pump, and means for conducting the water from said pump back into the conduit.

10. In combination, a water conduit, a pump having its intake connected with said conduit, a turbine engine connected with said pump, a condenser, means for directing part of the water in said conduit through said condenser to cool the same, an exhaust pipe connecting the engine with said condenser, a suction pipe connecting the condenser with the intake of the pump, means for conducting the water from the pump back into the conduit fore or aft of the intake at will.

11. In combination, a water conduit leading through a vessel, a rotary pump having its intake connected with said conduit, a turbine engine connected with said pump, a condenser, means for directing part of the water flowing through said conduit through said condenser, an exhaust pipe connecting the engine with said condenser, a suction pipe connecting the condenser with the intake of the pump, means for conducting the water from the pump back into the conduit at will, and suction pipes connecting the inactive chambers of the engine with the intake of the pump to reduce skin friction in the engine.

12. In an apparatus for propelling vessels, the combination of a pair of parallel conduits, pumps and intake and return-pipes intermediate the conduits and adapted to withdraw part of the water from the conduits at low pressure and inject it again under high pressure into the conduits to impel the body of water therein.

13. In an apparatus for propelling vessels, the combination of a pair of parallel conduits, rotary pumps intermediate the conduits adapted to withdraw part of the water from the conduits and inject it again under high pressure into the conduits, and means for directing the return water from the pumps into the conduit in front of or in rear of the intake of the pumps at will.

14. The combination of a pair of conduits, rotary pumps therebetween having intakes communicating with the adjacent conduits, rotary engines driving said pumps, and means for directing the water from the pumps back into the conduits, said pumps adapted to withdraw water from the conduit and return it thereinto at a higher velocity.

15. The combination of a pair of conduits, axially alined rotary pumps therebetween having intakes communicating with the adjacent conduits, axially alined rotary engines intermediate and driving said pumps, and means for directing the water from the pumps back into the conduits, said pump adapted to withdraw water from the channel and return it thereinto at a higher velocity.

16. The combination of a pair of conduits, rotary pumps therebetween having intakes communicating with the adjacent conduits, rotary engines driving said pumps, and means for directing the water from the pumps back into the conduits; with a condenser connected with said pumps, and suction pipes connecting the condenser with the intakes of the pumps, substantially as described.

17. The combination of a pair of conduits, axially alined rotary pumps therebetween having intakes communicating with the adjacent conduits, axially alined rotary engines intermediate and driving said pumps, and means for directing the water from the pumps back into the conduits; with a condenser connected with each of said pumps, means for directing part of the water from said conduits through the condensers, and suction pipes connecting the condensers with the intakes of the pumps, substantially as described.

18. In combination with a conduit adapted to be placed in a vessel, a head at the end of the conduit having a flaring mouth, wing-valves in said mouth at opposite sides thereof, and means for partly or wholly closing said valves; with pumps adapted to withdraw a portion of water from the channels and return it thereinto at a high pressure, and an engine for operating said pumps.

19. In combination, a pair of conduits adapted to be placed in a vessel, a head at the end of the conduits communicating therewith and having a flaring mouth, valves hinged in said mouth at opposite sides thereof; with rotary pumps adapted to withdraw a portion of water from the channels and return it thereinto at a high pressure, and rotary engines for operating said pumps, substantially as described.

20. In combination with a conduit adapted to be placed in a vessel, a head at the end of the conduit having a flaring mouth, wing-valves in said mouth at opposite sides thereof, and means for partly or wholly closing said valves; with pumps adapted to withdraw a portion of water from the channels and return it thereinto at a high pressure, and an engine for operating said pumps; a condenser connected with the exhaust of said engine, means for directing water from the conduit through said condenser, and a suction pipe connecting said condenser with the inlet of the pump.

21. In combination, a pair of conduits adapted to be placed in a vessel, a head at the end of the conduits communicating therewith and having a flaring mouth, valves hinged in said mouth at opposite sides thereof; with rotary pumps adapted to withdraw a portion of water from the channels and return it thereinto at a high pressure, and rotary engines for operating said pumps, condensers connected with the exhaust of said engines, means for directing water from the conduits through said condensers, and suction pipes connecting said condensers with the inlets of the pumps.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

HENRY A. DUC, JR.

In presence of—
JAMES R. MANSFIELD,
L. E. WITHAM.