No. 624,348.

Patented May 2, 1899.

A. H. LIGHTHALL.

MARINE ENGINE.

(Application filed Aug. 8, 1898.)

(No Model.)

4 Sheets—Sheet 1.

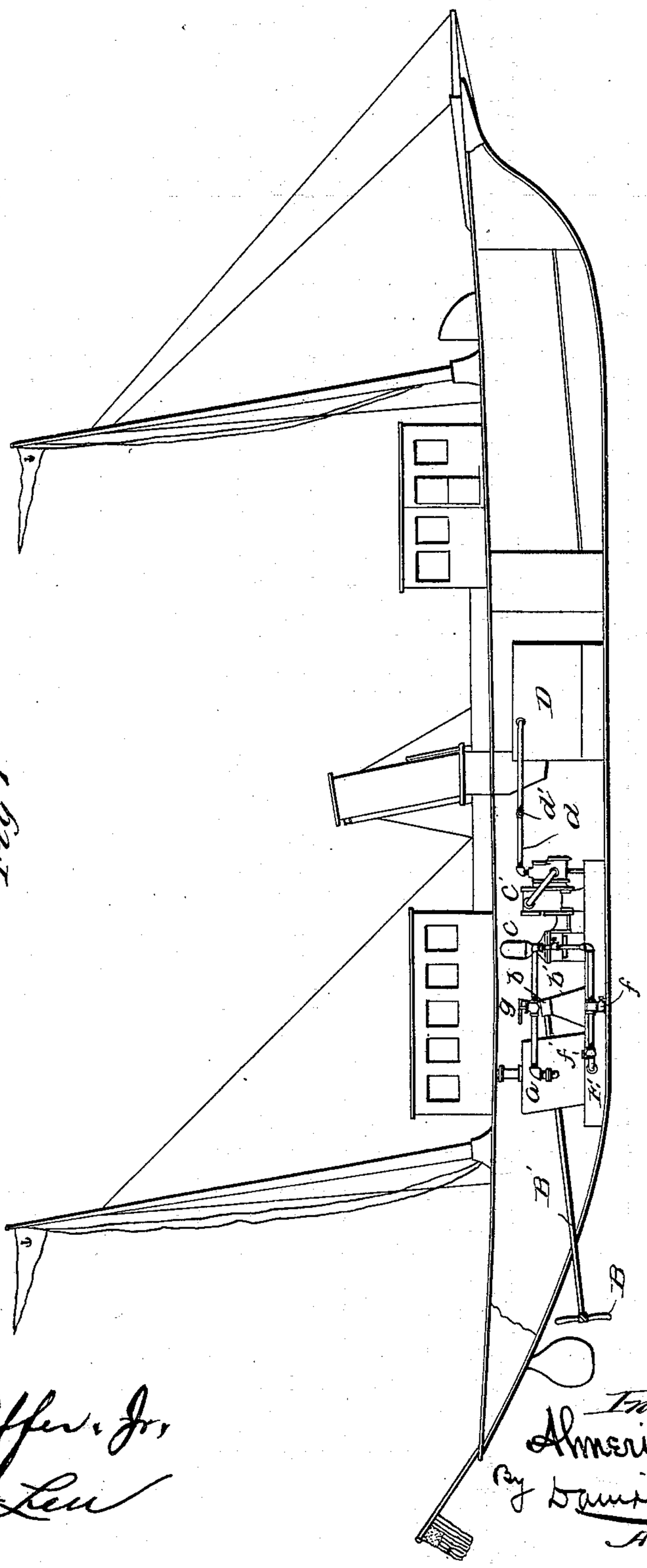

Fig. 1.

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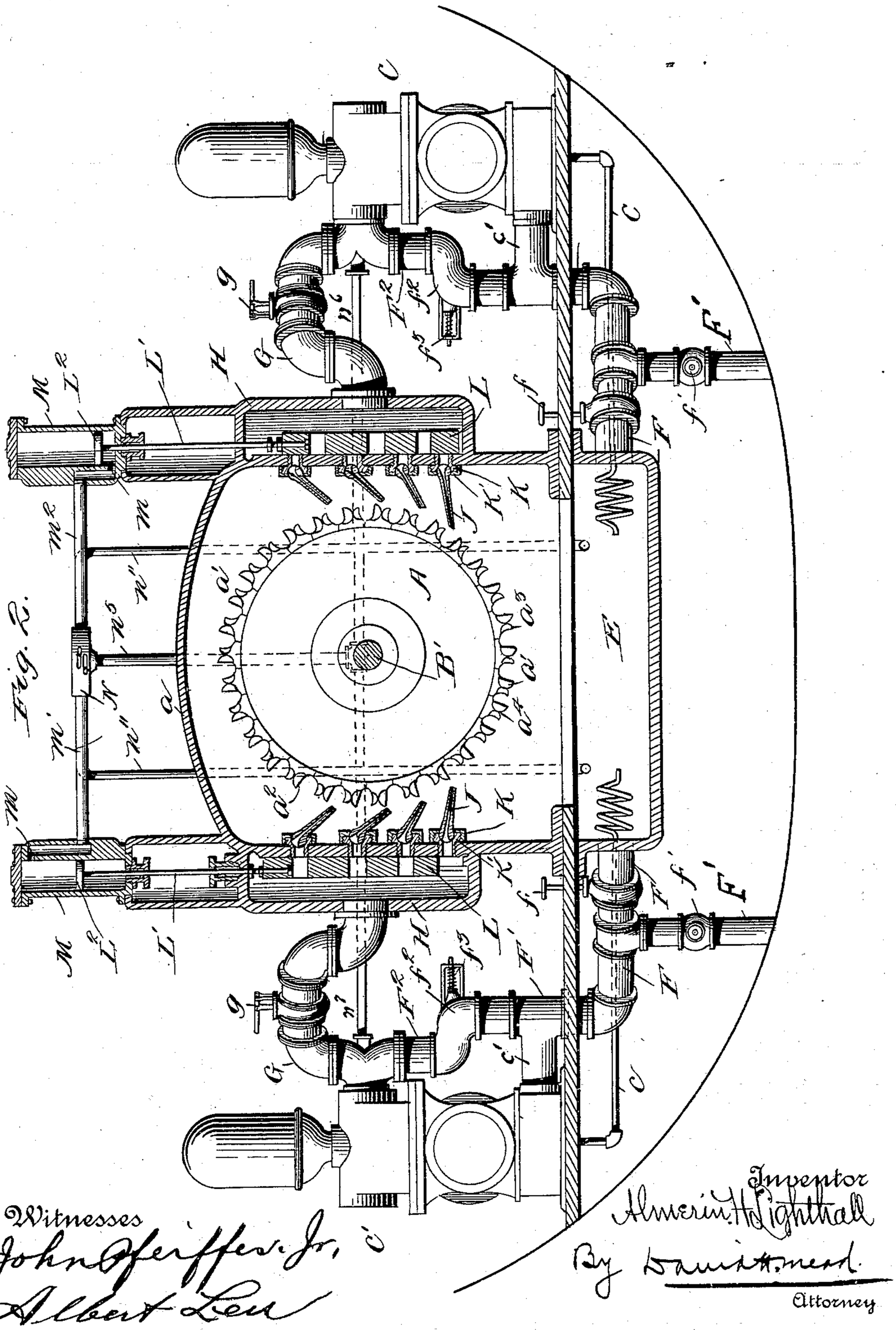
(No Model.) 4 Sheets—Sheet 2.



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(No Model.) 4 Sheets—Sheet 3.

Fig. 3.

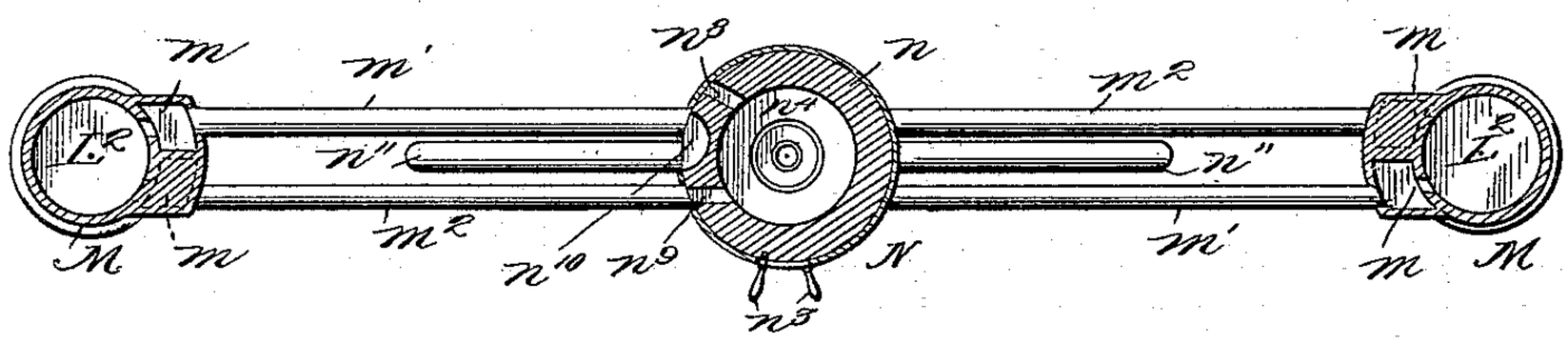


Fig. 4

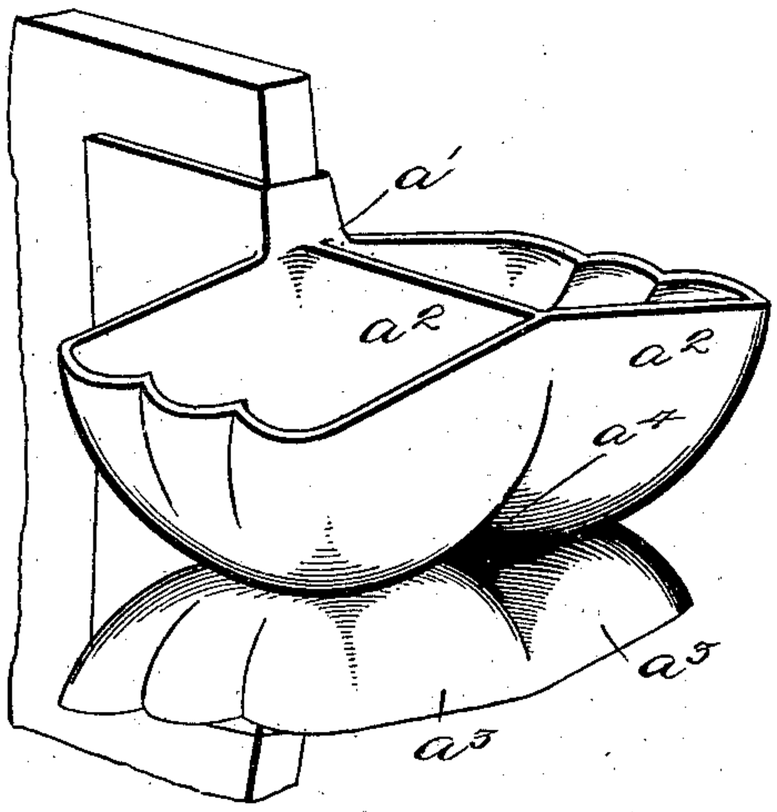


Fig. 5.

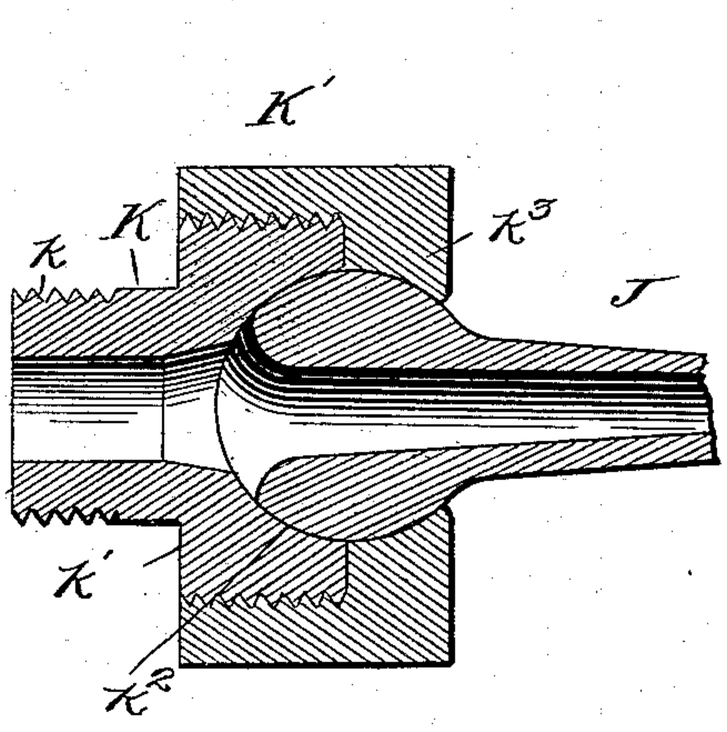
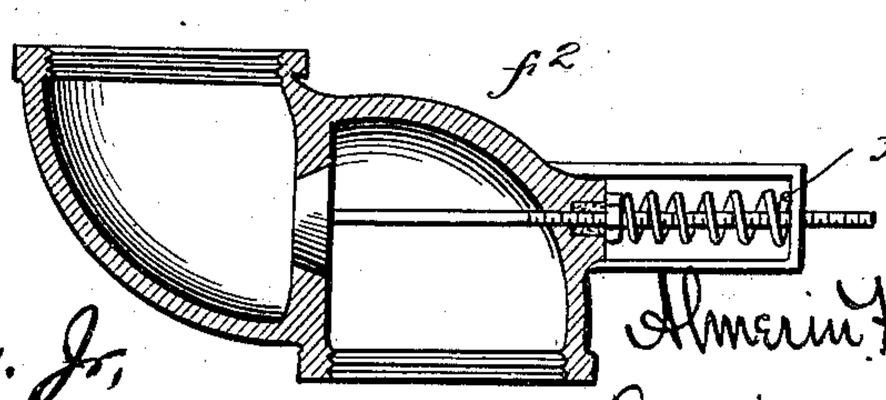


Fig. 9



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(No Model.) 4 Sheets—Sheet 4.

Fig. 6.

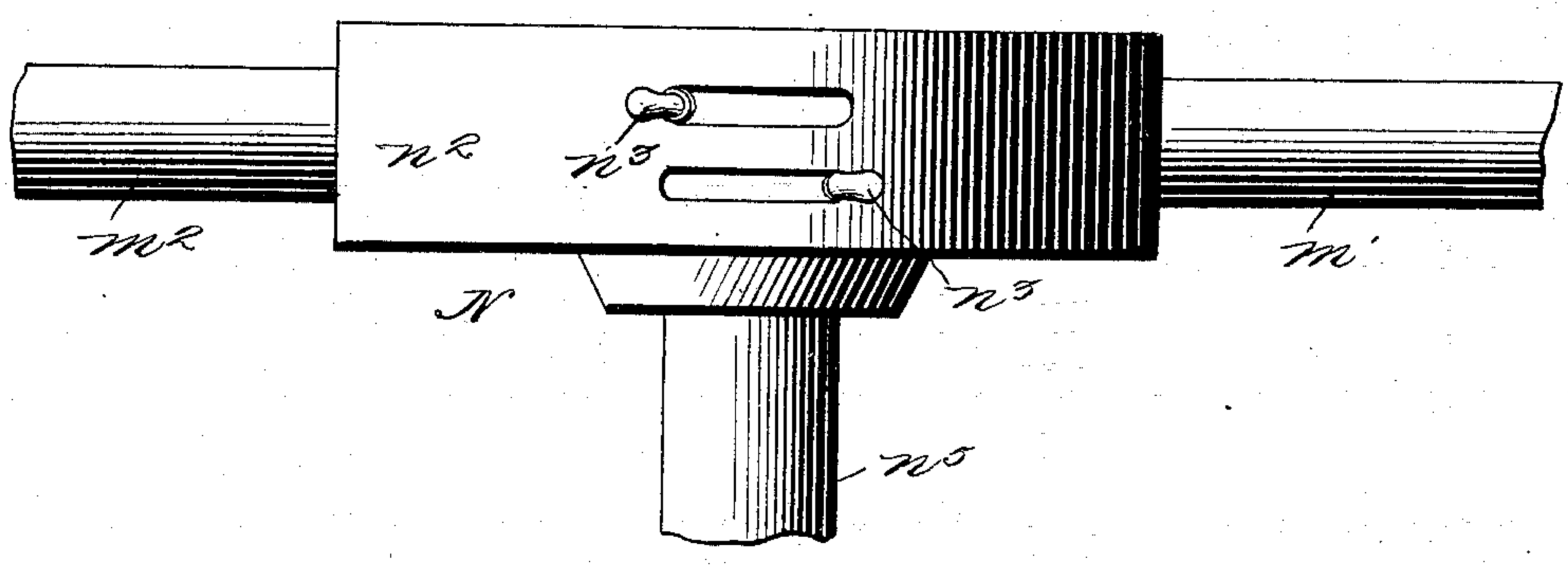


Fig. 7.

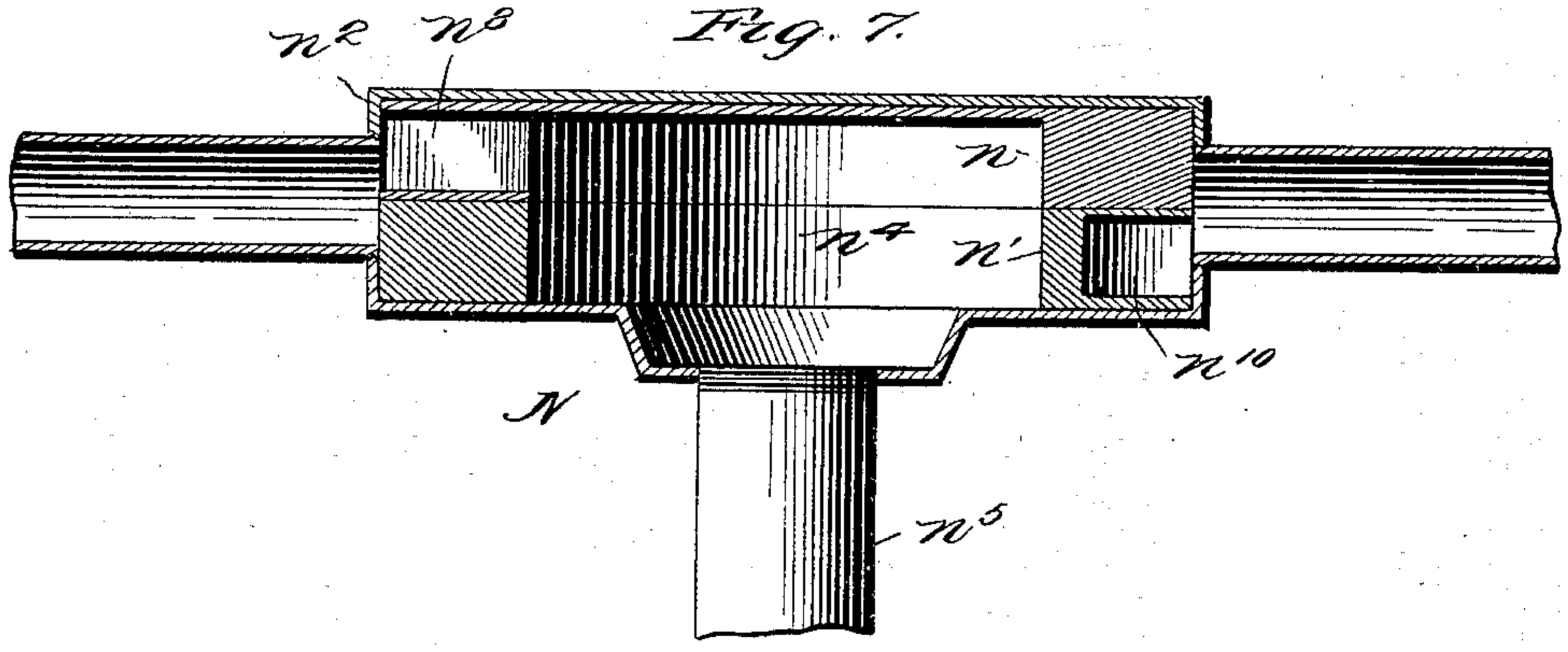
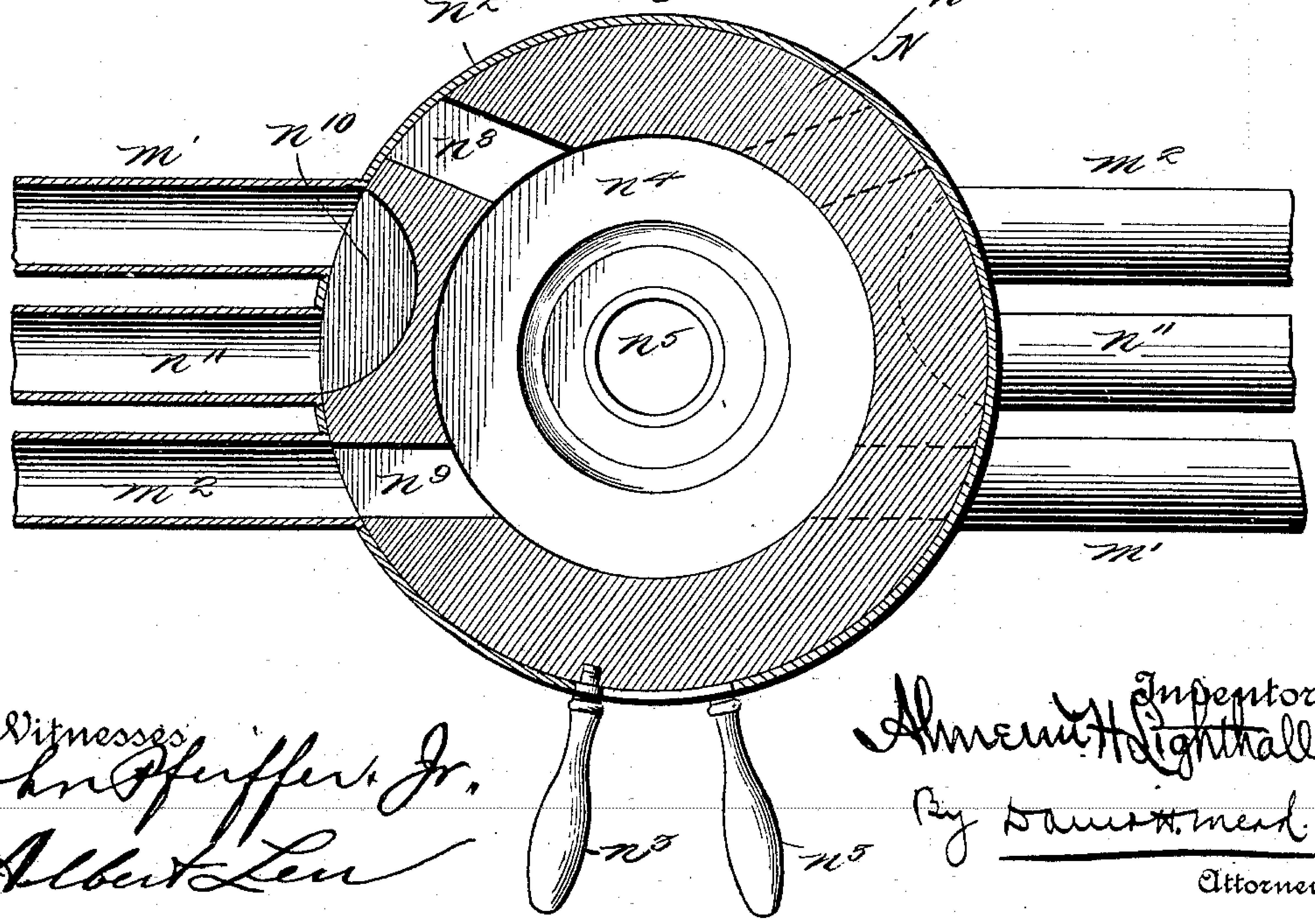


Fig 8



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ALMERIN H. LIGHTHALL, OF NEW YORK, N. Y., ASSIGNOR TO HENRY A. MAURER, OF SAME PLACE.

MARINE ENGINE.

SPECIFICATION forming part of Letters Patent No. 624,348, dated May 2, 1899.

Application filed August 8, 1898. Serial No. 688,076. (No model.)

To all whom it may concern:

Be it known that I, ALMERIN H. LIGHTHALL, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Marine Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to marine propulsion.

The primary object of the invention is to provide a marine engine capable of taking the place of engines directly energized by steam, gas, vapor, or air and which will overcome the disadvantages incident to such use of these fluids in marine propulsion and be capable of operation at less cost than any of the engines operated in the usual way by the fluids referred to.

With these objects in view the invention consists, essentially, of a marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel provided with buckets or vanes, and means for projecting water under pressure against the buckets or vanes.

Further, the invention consists of various novel constructions and aggroupments of elements.

Finally, the invention consists of various novel details of construction and arrangements of parts, all substantially as hereinafter described and as set forth in the claims.

One form of embodiment of the invention is illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of a vessel having my motor applied thereto. Fig. 2 is a view, partly in section, showing the motor-wheel, the means for projecting water against the wheel, and the means for controlling and regulating such projection. Fig. 3 is a plan view, partly in section, of the valve and connections for regulating the flow of water to the cylinders for controlling through slide-valves the discharge of water upon the motor-wheel. Fig. 4 is a perspective view of a bucket or vane of the form preferably employed on the water-wheel. Fig. 5 is a detail sectional view of the means of securing the nozzles in position. Fig. 6 is a side view of the valve for governing the flow of water by which the water-supply valves are operated. Fig. 7 is a central vertical sectional view of the valve. Fig. 8 is a plan view of the valve with the upper part of the casing of the valve removed, and Fig. 9 is a detail view of the valve in the pipes connecting the suction and discharge ends of the pumps.

In the drawings, A represents the motor or water wheel, which receives motion from the impact of water projected against it, the water being put under pressure and its flow being regulated and governed by the means hereinafter described and claimed. The motor-wheel is preferably inclosed in a casing a, as shown in Fig. 1 of the drawings.

The periphery of the motor-wheel has attached to it a series of buckets a', arranged in close proximity to each other, and which buckets are provided with two cups on each side, the cups a^2 a^2 being of somewhat greater area than the cups a^3 a^3 and there being an indentation a^4 on the outer face of the buckets or vanes. Water from nozzles is projected against the cups a^2 a^2 when a forward motion is to be given the vessel, while the smaller cups a^3 and the indentation a^4 receive the impact of water when a reverse or backward movement is to be given. I do not of course confine myself to the use of the described bucket, as any bucket suitable for the purpose may be employed, nor do I claim the specific form of bucket herein, as the same forms the subject-matter of a separate application for patent, Serial No. 688,077.

A propeller B, which may be of any suitable or desirable form, is mounted on a propeller-shaft B′, which is rigidly attached to the center of the motor-wheel A by keying or otherwise. The propeller-shaft B′ is of a length to retain the propeller at a proper distance from the stern of the vessel, as shown in Fig. 1 of the drawings, and preferably extends down-

ward from the stern at an angle. The forward end of the propeller-shaft is mounted in a suitable bearing *b*, mounted on a standard *b'*, upon which bearing the thrust of the shaft is imposed and by which the shaft is retained in position.

The water by which motion is given the water-wheel is supplied under desired pressure by pumps C C', arranged in as close proximity to the wheel as possible in order to avoid unnecessary friction in the conduits by which the water is conducted from the pumps to the nozzles from which it is projected. Steam for the operation of the pumps C and C' is obtained from a suitable boiler or boilers D, connected by suitable steam-pipes *d*, having valves *d'* therein for turning or cutting off and regulating the supply of steam to the pumps. One of the steam-pipes is shown in Fig. 1 of the drawings. The exhaust-steam from the pumps is conveyed by suitable condenser-pipes *c* from the pumps to a well E, arranged below the water-wheel. These exhaust-pipes terminate in coils which are immersed in the water contained in the well, so that they are kept cool. Therefore the exhaust-steam passing through the pipes will be condensed and the water of condensation will flow into the well E and be retained there until used in the generation of steam or for supplying the pumps C and C'.

The water to be forced against the motor-wheel can be carried by the well E, which is in a location to receive the water when its energy is exhausted after being discharged against the wheel, or the supply of water may be obtained from the body in which the vessel floats. To this end the suction-inlets *c'* of the pumps are connected by pipes F with the well E, and branch pipes F' are connected with the suction-pipes F and are extended through the shell of the vessel and extend into the water in which the vessel floats. The suction-pipes F are provided with valves *f* and the branch pipes are provided with valves *f'*, so that by opening the valve in one pipe and closing that in the other the water may be drawn either from the well or from the outside of the vessel, or by opening the valves in each of the pipes water may be drawn from both sources. Each pump is provided with a discharge-pipe G, by which each pump is connected to one of the water-chests H, from which the water is discharged upon the wheel from one side or the other, as desired, to revolve the wheel in the required direction. Each pipe G is provided with a cut-off valve *g*.

In order that one or both of the pumps may be kept running continuously independently of the discharge of water upon the wheel, and thus the water retained under pressure ready for instant use to move the wheel in one direction or the other, I provide each of the pumps with a pipe F^2, connected at one end to the inlet or suction end of the pump and at the other end to the outlet. The pipe F^2 is provided with a relief-valve f^2. The relief-valve has a spring f^3, the tendency of which is to keep the valve closed, and means for giving more or less tension to the spring. Thus when the flow of water through the pipe G of one of the pumps is cut off by the valve *g* while the pump is operating the relief-valve f^2 will, when sufficient pressure exists in the pipe F^2, be opened. The result of this construction is that the pumps may be kept operating continuously, and when the discharge of water to one of the chests is cut off the relief-valve will automatically be opened, with the result that the water will simply circulate through the pump and the pipe F^2, being thus kept under pressure ready for immediate use. The water after being received by the water-chests H is discharged against the buckets on the wheel A through nozzles J, attached to the inner faces of the chests and arranged to direct the water in any desired direction against the buckets or vanes on the water-wheel. Any suitable number of these discharge-nozzles may be used, and in the present illustration of the invention I have shown the water-chest as provided with four, each extending in proper direction to project water against the buckets or vanes in a way to be most effective. In order that the attachment, detachment, and adjustment of the nozzles may be readily and easily accomplished, I preferably employ the means of attachment shown in Figs. 2 and 5 of the drawings. This consists of a tap or plug K, having an externally-screw-threaded end *k*, adapted to enter suitable openings in the inner face of one of the chests H, and also having an enlarged outer end *k'*, externally screw-threaded and provided with a curved socket k^2. The inlet ends of the nozzle J are spherical in general contour and of a size to fit snugly into the socket in the outer end of the tap or plug K. The inlet end of the nozzle and the tap or plug are connected by a collar K', screw-threaded on its inner face and provided with an inward-extending flange having its inner face curved to conform to the outer face of the spherical portion of the nozzle. By this construction the nozzles are allowed to be moved to point their discharge ends in any direction from the water-chest when the collar K' is loose, and by tightening the collar the parts are bound together and the nozzle retained rigidly in place by frictional contact.

The taps or plugs K extend through the inner walls of the water-chests H, and when the openings in them are unobstructed water under pressure in the chests will be projected from all the nozzles. In order that these openings may be opened or closed or partly opened or closed by the exercise of little exertion on the part of an operator, I employ the means now to be described.

Arranged in each of the water-chests H is

a vertically-movable valve L, having openings of a width corresponding to the size of the opening in the taps or plugs K and solid portions of about the same size alternately arranged. Connected with these valves are rods L′, which extend upward into cylinders M and are provided at their ends with piston-heads L^2. The cylinders M have ports *m*, respectively at their upper and lower ends, and with these ports are connected pipes m' m^2, extending to a valve or cock N, by which the inlet or discharge of water under pressure is admitted or allowed to exhaust from one end or the other of either of the cylinders to move the piston-heads L^2, and consequently the valves, to govern the discharge of water through the nozzles J from the water-chests.

The valve N consists, essentially, of two disk portions *n* and *n′*, arranged one above the other in a casing n^2 and each provided with a projecting handle n^3 for operating it. The center of each disk *n n′* is open, forming a chamber n^4, with which communicates a pipe n^5. This pipe is supplied with water under pressure from the pumps through pipes n^6 and n^7. Each disk of the valve N has two openings n^8 and n^9, connecting with the inner chamber n^4 and capable of registering with the pipes m' and m^2, and each is also provided in its periphery between the openings n^8 and n^9 with an indentation n^{10}. The pipes m' and m^2 from the two cylinders M are connected with the shell of the valve on each side thereof, and between these pipes on each side is an outlet or exhaust pipe n^{11}, also connected to the shell of the valve and extending to the well E or to some other convenient place of discharge.

In the operation of the valve to allow the inlet of water, for instance, to move one of the piston-heads L^2 upward and thereby raise the valve to partially or entirely open the passages to the discharge-nozzles on one side of the wheel a disk will be moved to bring the parts to the position shown in full lines in Fig. 8 of the drawings. When the parts are in this position, water under pressure will flow through the opening n^9 in the valve-disk and pass through the pipe m^2 to the lower part of a cylinder M, through which it enters below the piston-head and raises the latter. At the same time the water contained in the cylinder above the piston-head will be forced out and will flow from the cylinder, through a pipe m', to the valve N. When the pipe m^2 registers with the opening n^9, the indentation n^{10} is in a position to connect the pipe m' and the outlet n^{11}, so that the water flowing from the cylinder will pass through the pipe m', the indentation n^{10}, and then will be discharged into the well E or at some other suitable place. In moving the parts in the opposite direction to wholly or partially close the openings to the nozzles the opening n^8 is brought to register with the pipe m', and thus the indentation n^{10} will connect the pipe m^2 with the discharge-pipe n^{11}, the result being to force down the piston-head by the inlet of water under pressure above it and to allow the escape of the water contained in the cylinder below the piston-head.

The piston-head and consequently the valve may be retained in any desired position to which they may be moved by turning the disk to bring the blank spaces between the indentation n^{10} and the openings n^8 and n^9 in front of the pipes m' and m^2. This movement will confine water above and below the piston-head and retain the same and the parts connected thereto rigidly in place.

The valve N is shown in the drawings as located adjacent to the cylinders which it controls; but obviously, if desired, it may be placed in the pilot-house or in any other suitable place, or two such valves properly connected with the cylinders may be employed, one to be located near the cylinder and one in the pilot-house or at some other point.

In the operation of a marine engine constructed as described steam generated in the boiler D is utilized in the most effective manner possible, there being practically no loss in energy, and the use of an expensive engine is entirely dispensed with. Motion is given the water or motor wheel A and the propeller, connected to the wheel, in either direction by directing the water forced under pressure from the pumps through one or the other sets of nozzles, and the speed of revolution is susceptible of modification either by regulating the quantity of steam supplied the pumps or by allowing the pumps to run at a uniform speed and by regulating by the slide-valve the quantity of water under pressure projected against the cups or vanes of the wheel. In case the pressure of water in the pump-outlet pipe should become too great by reason of wholly or partially cutting off the discharge through the nozzles the relief-valve will open and allow the passage of water to the suction end of the pump.

The great advantages which the herein-described means of propulsion have over those ordinarily in use are that the construction is cheap both in first cost and in operation and is not liable to the wear and tear incident to the latter. For instance, in my engine the direction of revolution of the propeller may be reversed with no appreciable shock to the driving mechanism or to the vessel. This arises from the fact that there is no connection between the motor-wheel, which is connected to the propeller, and the means by which the wheel is propelled. The water ejected against the wheel is preferably gradually shut off on one side as it is turned on at the other in changing direction of revolution, and thereby a cushion of water is formed, balancing the wheel and preventing jars. As the water once ejected from the nozzles cannot be forced back by coming in contact with the buckets or vanes of the wheels, no reaction which would result in vibration of the parts of the motor takes place.

A great disadvantage incident to the use of propellers as ordinarily connected to and driven by engines is the injurious effect of "racing." In a propeller-shaft driven by rigid connection with a steam-engine the speed and power of the shaft are increased as the propeller is raised from the water, because as the load is taken from the shaft the valves of the engine work more rapidly, admitting more steam to the cylinders. Consequently when the propeller is returned to the water it strikes it with great force and the engine and vessel receive injurious shocks. In the construction herein shown and described, while the speed of the propeller will naturally increase as it is raised from the water, the shaft, impact-wheel, and propeller running freely, the actual power applied to the shaft is decreased for the reason that in the action of an impact water-wheel the greatest efficiency is attained when the peripheral speed of the wheel is half that of the jet velocity of the water by which the wheel is driven. As the propeller returns to the water after being raised thereform there is no shock, and as the resistance to its revolution is presented by contact with water the power necessary to drive the vessel is gradually attained. Thus the speed of the propeller is automatically governed in the pitching of the vessel.

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

1. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel provided with buckets or vanes arranged on the inner portion of the shaft, and means for projecting water under pressure against the buckets or vanes, substantially as described.

2. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel provided with oppositely-arranged cups or vanes arranged on the inner portion of the shaft and nozzles for directing water under pressure into the buckets or vanes, substantially as described.

3. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel mounted on the inner portion and provided with buckets or vanes, a casing surrounding the water-wheel, and nozzles for projecting water under pressure against the buckets or vanes, substantially as described.

4. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel provided with buckets or vanes arranged on the inner portion of the shaft, a casing inclosing the water-wheel, and nozzles arranged on opposite sides of the wheel for projecting water against the buckets or vanes in opposite directions for rotating the wheel in one direction or the other, substantially as described.

5. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel having buckets or vanes and mounted on the inner portion of the shaft, nozzles for directing water under pressure against the buckets or vanes, pumps for supplying water under pressure to the nozzles, a well situated below the wheel, and a connection between the well and the pumps, substantially as described.

6. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller arranged on the outer portion of the shaft, an impact water-wheel mounted on the inner portion of the shaft, and provided with buckets or vanes, nozzles for projecting water under pressure against the buckets or vanes, pumps for supplying water under pressure against the buckets or vanes, a well situated below the wheel, connections between the wheel and the suction end of the pumps, and connections between the suction ends of the pumps and the outside of the vessel, substantially as described.

7. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel having buckets or vanes arranged on the inner portion of the shaft, nozzles for projecting water under pressure against the buckets or vanes, pumps for supplying water under pressure to the nozzles, and connections provided with valves between the suction end and discharge-openings of the pumps, substantially as described.

8. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion, an impact water-wheel provided with buckets or vanes mounted on the inner portion, a casing surrounding the water-wheel, water-chests arranged in the sides of the casing, nozzles connected with the water-chests for projecting water against the buckets or vanes, valves governing the flow of water from the water-chests to the nozzles, and pumps for supplying water under pressure to the water-chests, substantially as described.

9. A marine engine comprising a propeller-shaft extending from the interior to the exterior of a vessel, a propeller mounted on the outer portion of the shaft, an impact water-wheel mounted on the inner portion of the shaft and provided with buckets or vanes, a casing inclosing the water-wheel, nozzles for

projecting water against the buckets or vanes, water-chests arranged in the casing and communicating with the nozzles, valves for governing the flow of water from the chests to the nozzles, rods connected to the valves each provided with a piston-head, cylinders having ports at each end receiving the piston-heads, and pipes for conducting water under pressure to and from the ports of the cylinders, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

ALMERIN H. LIGHTHALL.

Witnesses:

JOHN PFEIFFER, Jr.,

ALBERT LEU.