(No Model.)

7 Sheets—Sheet 1.

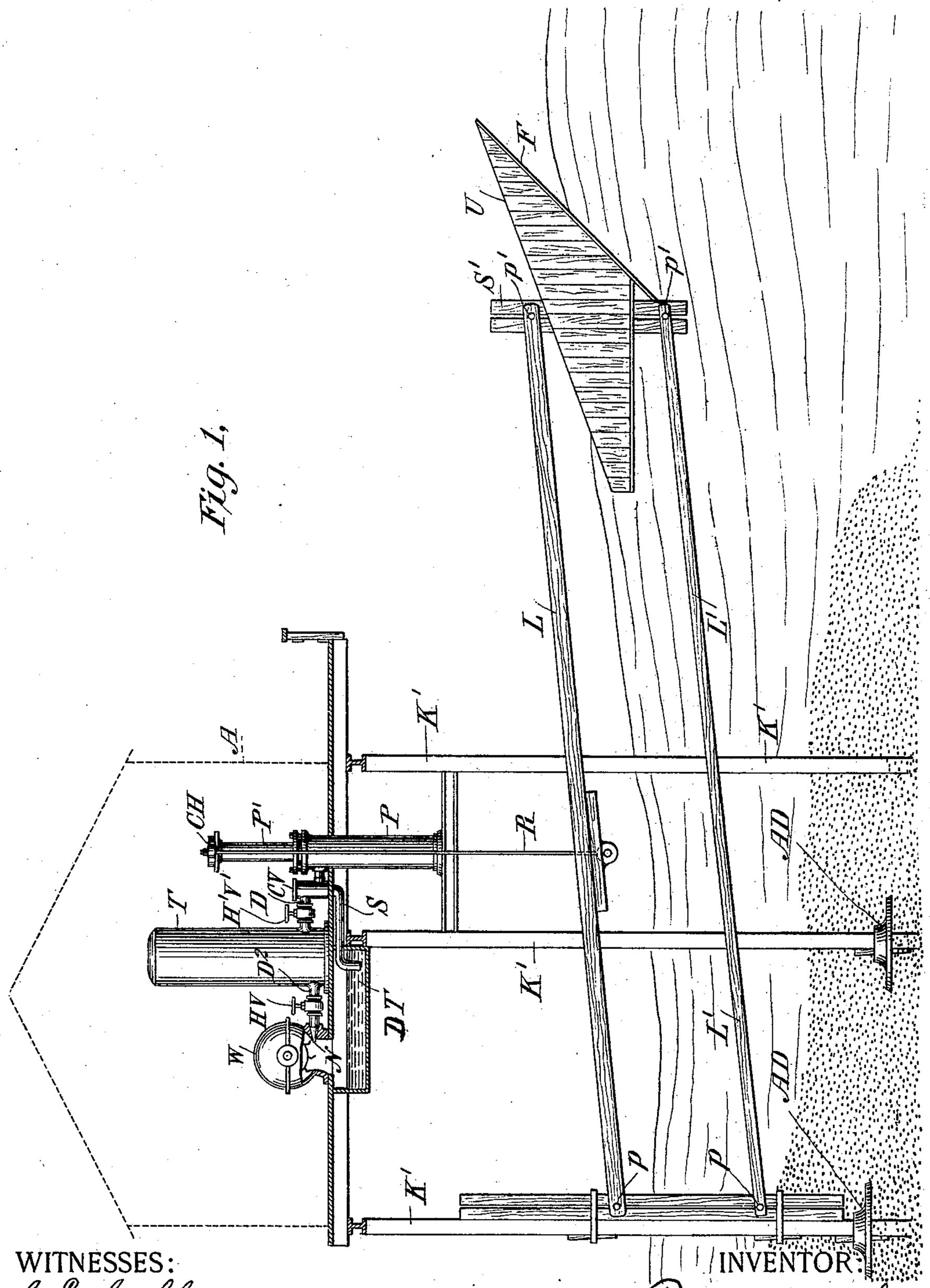
P. WRIGHT.

WAVE MOTOR.

No. 599,756.

Patented Mar. 1, 1898.

Fig. 1.



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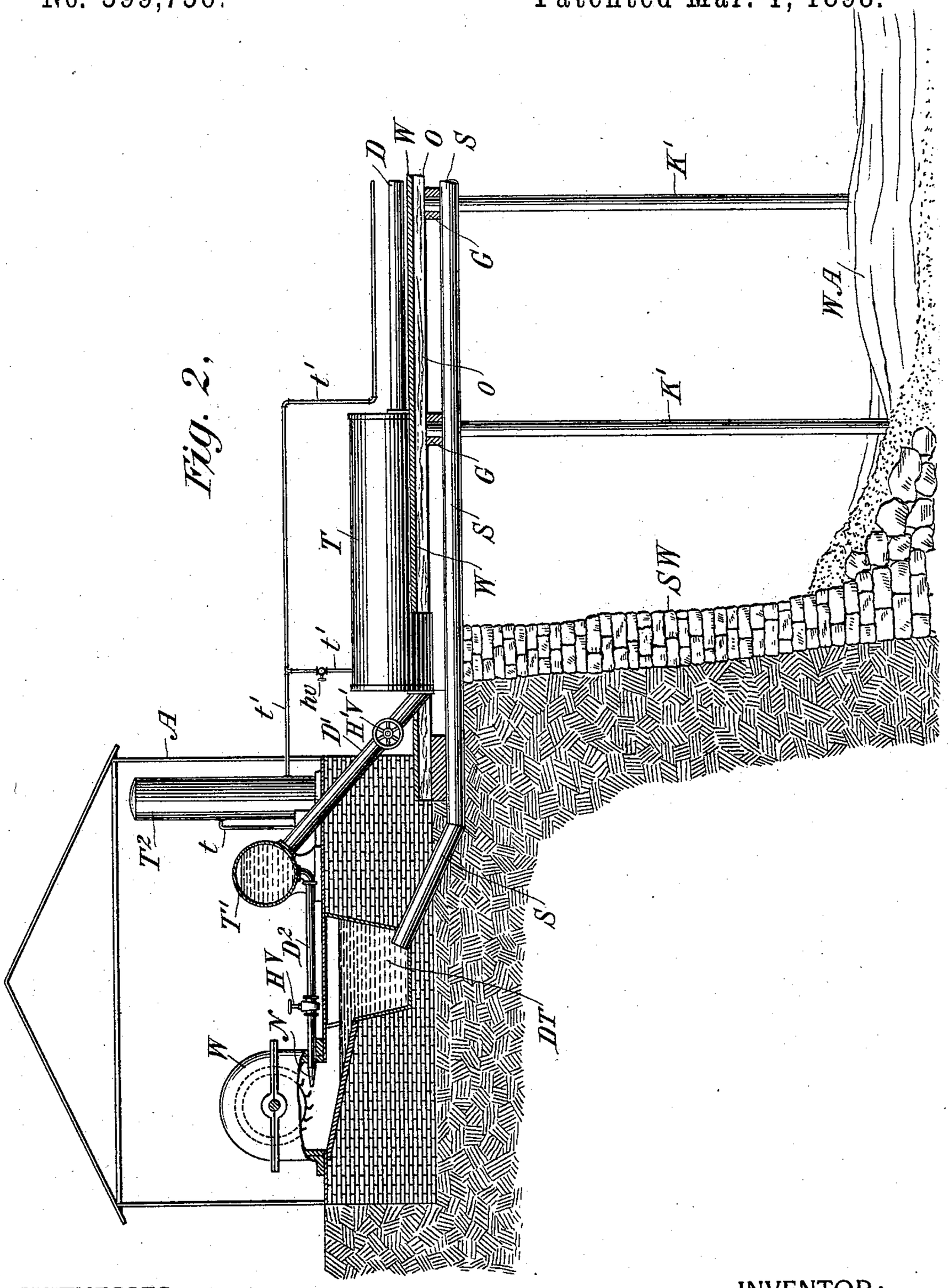
(No Model.) 7 Sheets—Sheet 2.

P. WRIGHT.

WAVE MOTOR.

No. 599,756. Patented Mar. 1, 1898.

Fig. 2,



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(No Model.) 7 Sheets—Sheet 3.

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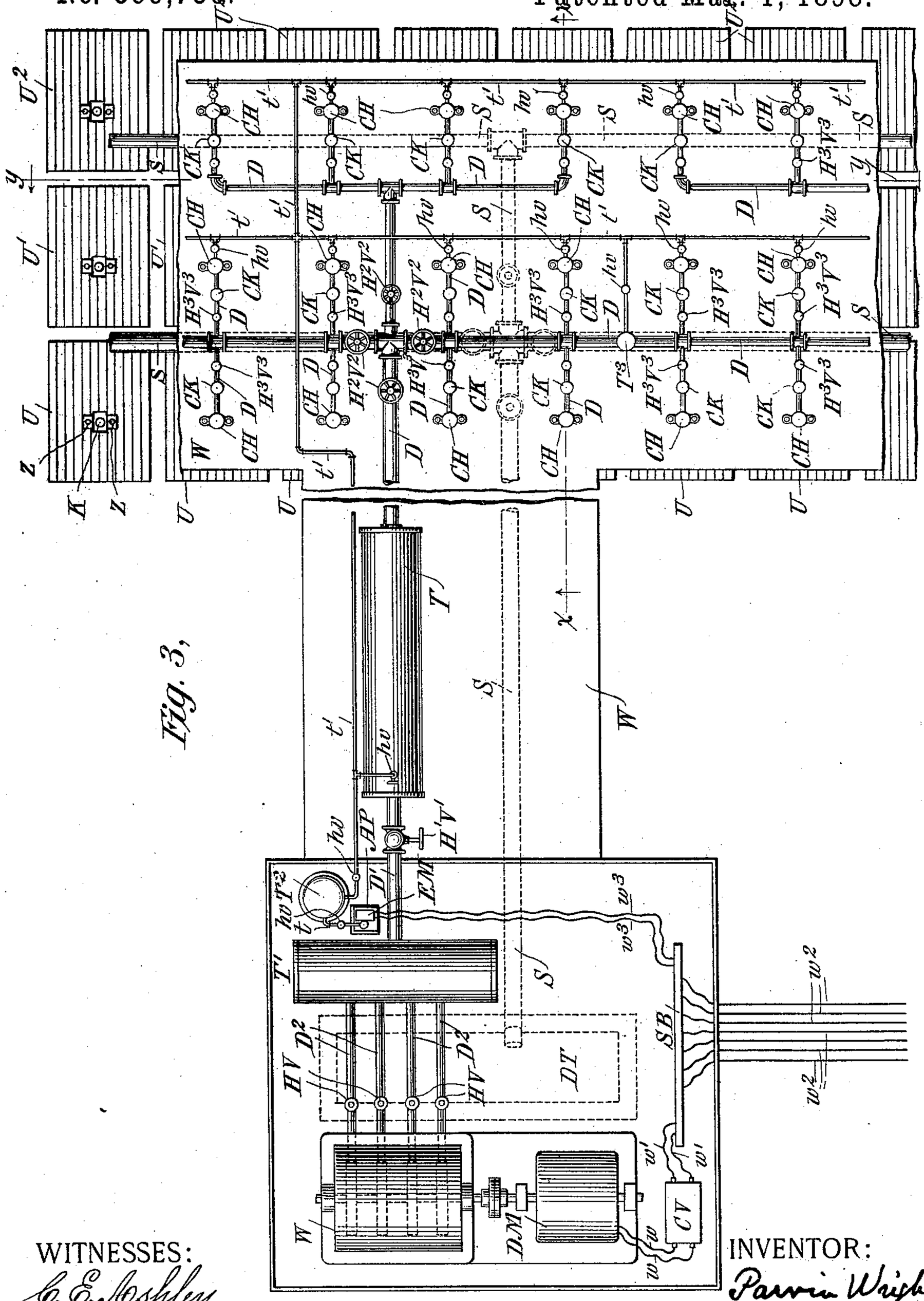

Fig. 3,

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(No Model.)

7 Sheets—Sheet 4.

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WAVE MOTOR.

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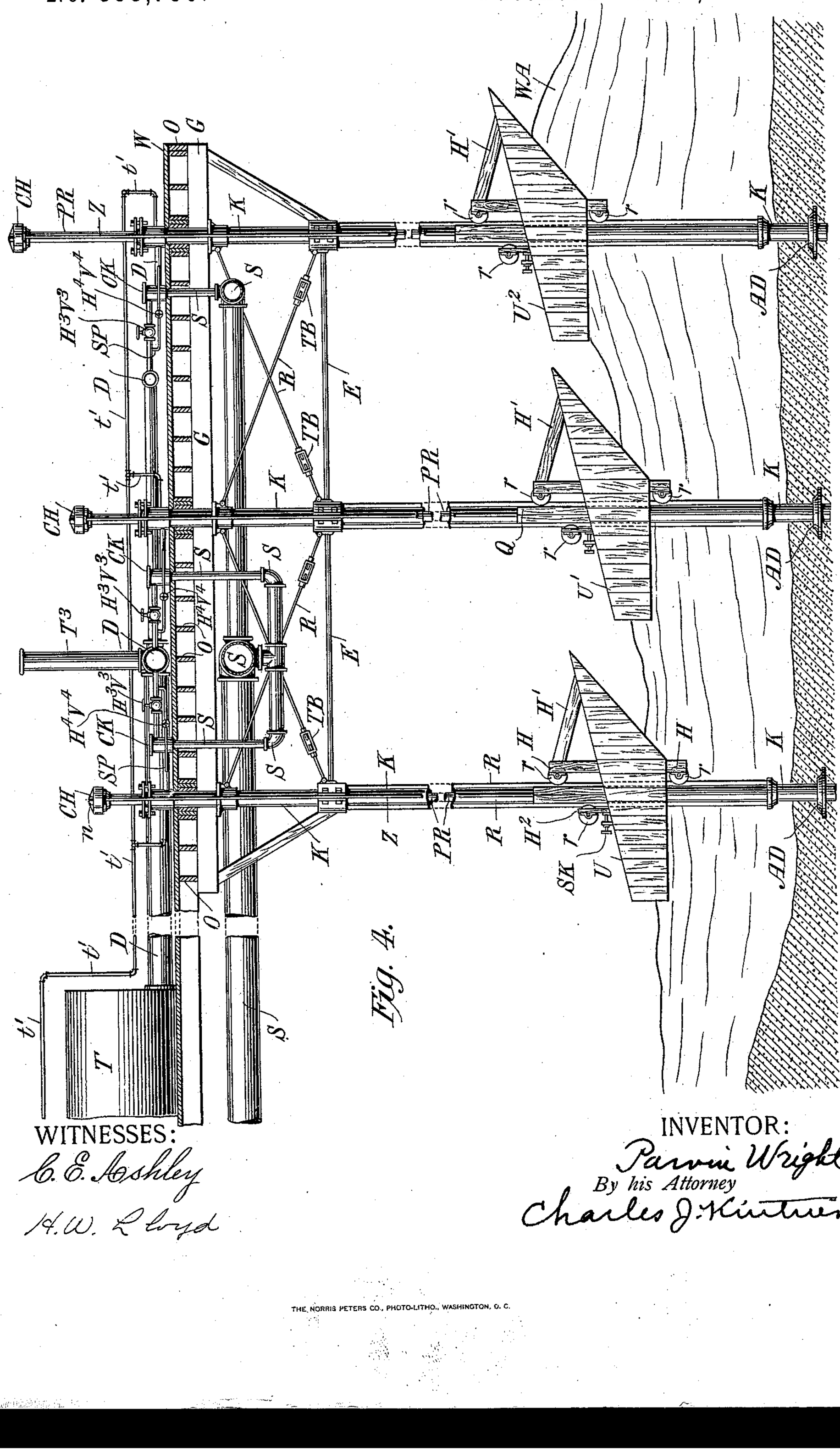

Fig. 4.

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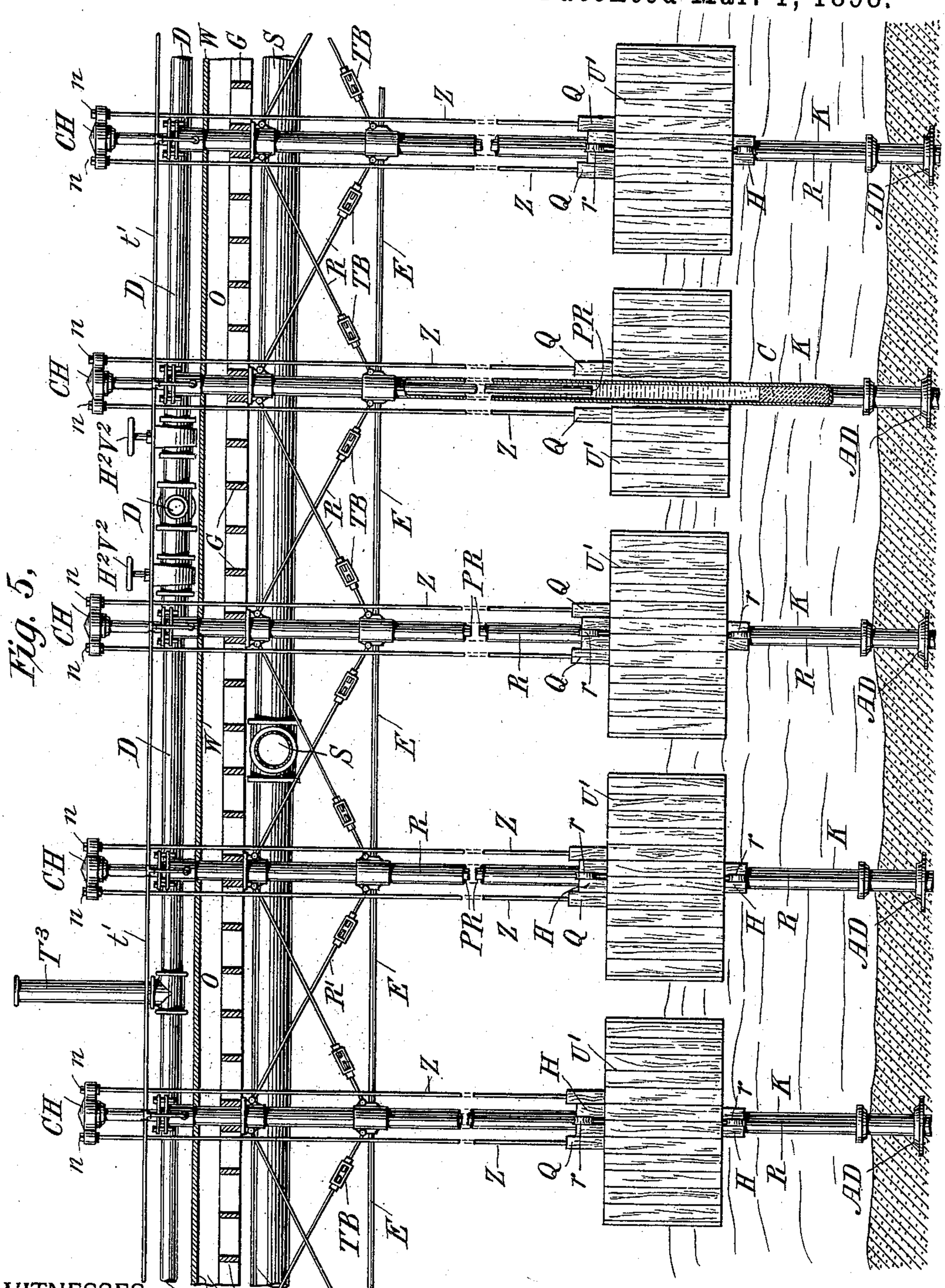
Fig. 5.



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7 Sheets—Sheet 6.

P. WRIGHT.

WAVE MOTOR.

No. 599,756.

Patented Mar. 1, 1898.

Fig. 6,

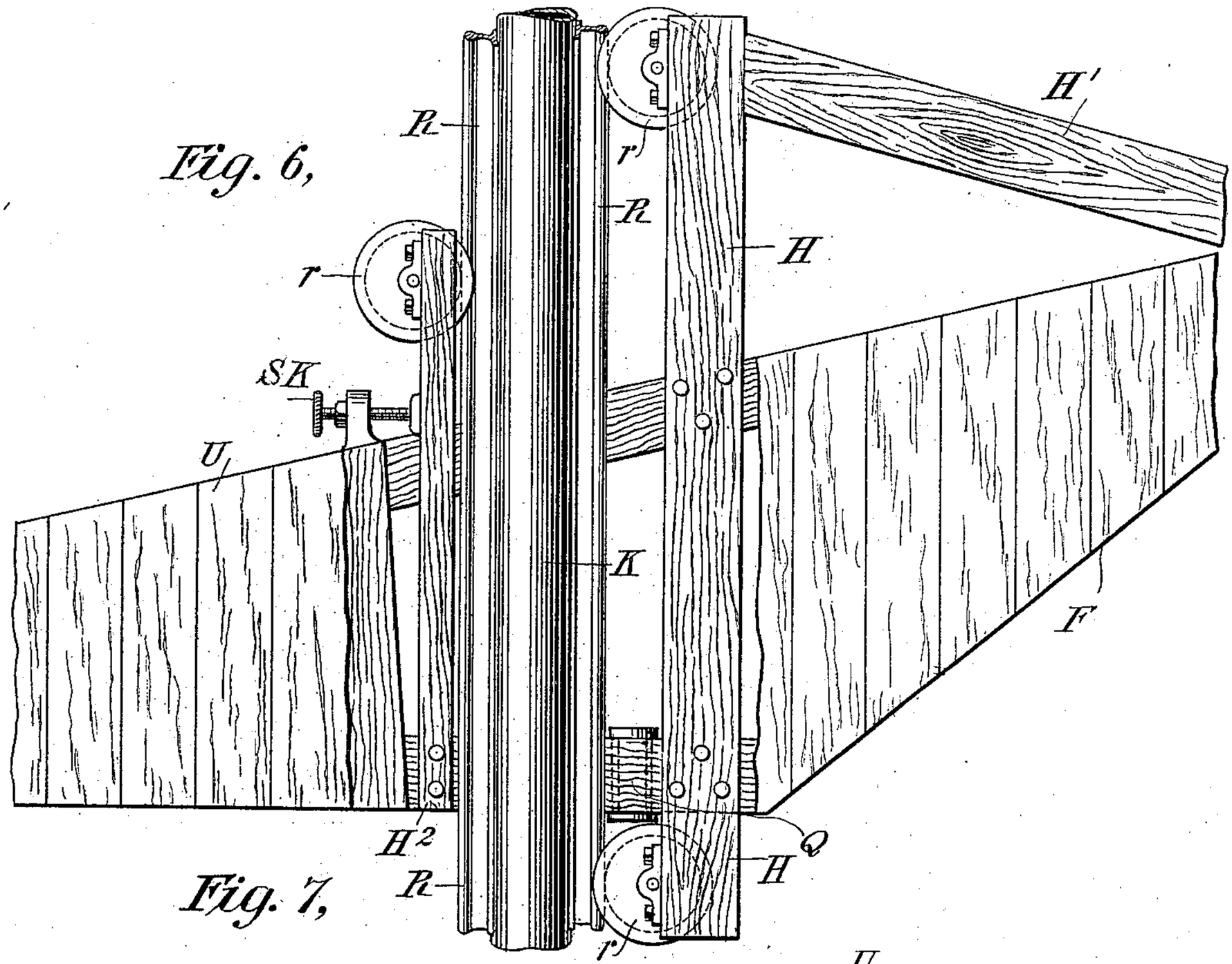
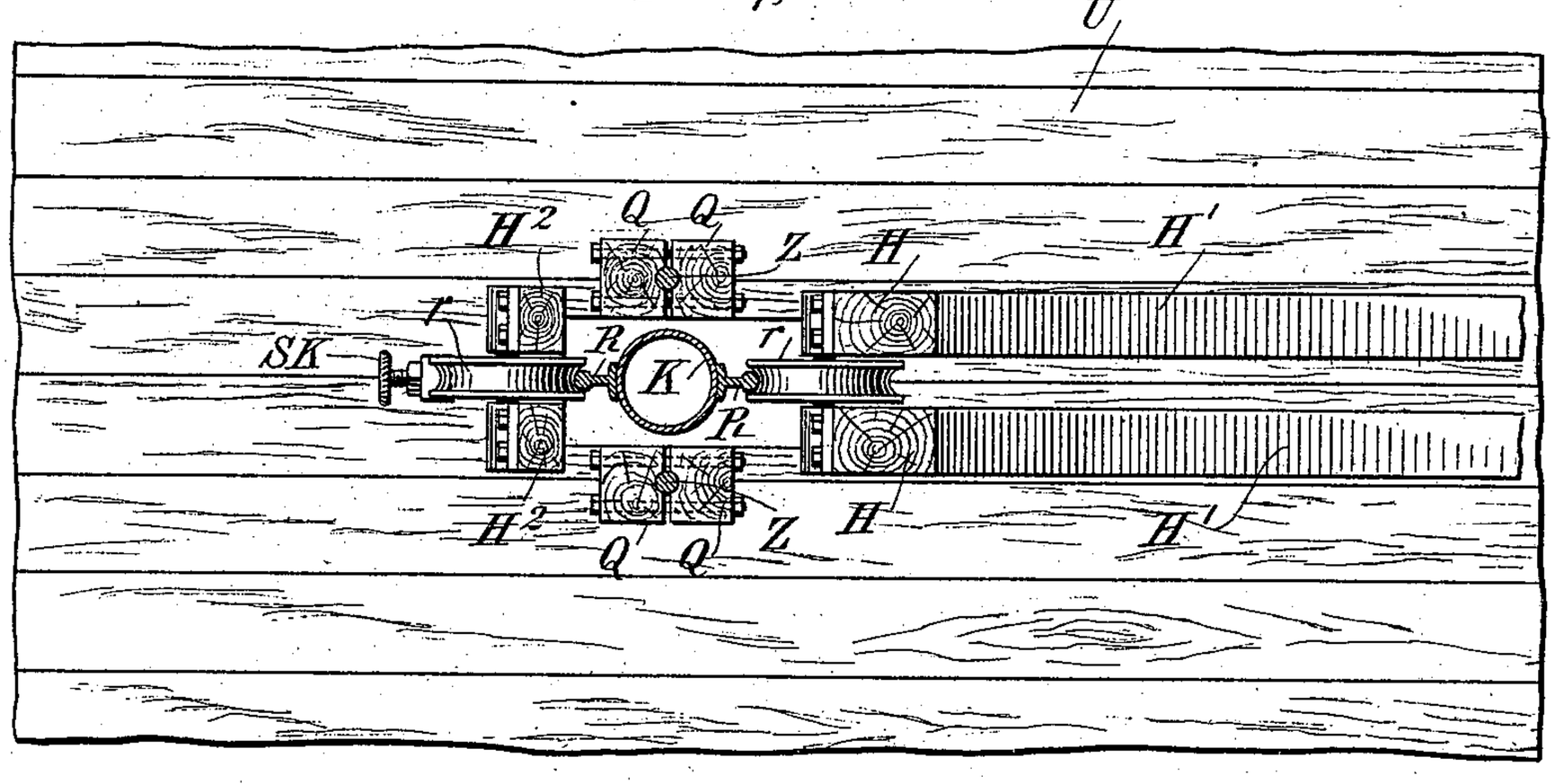


Fig. 7,



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7 Sheets—Sheet 7.

P. WRIGHT.

WAVE MOTOR.

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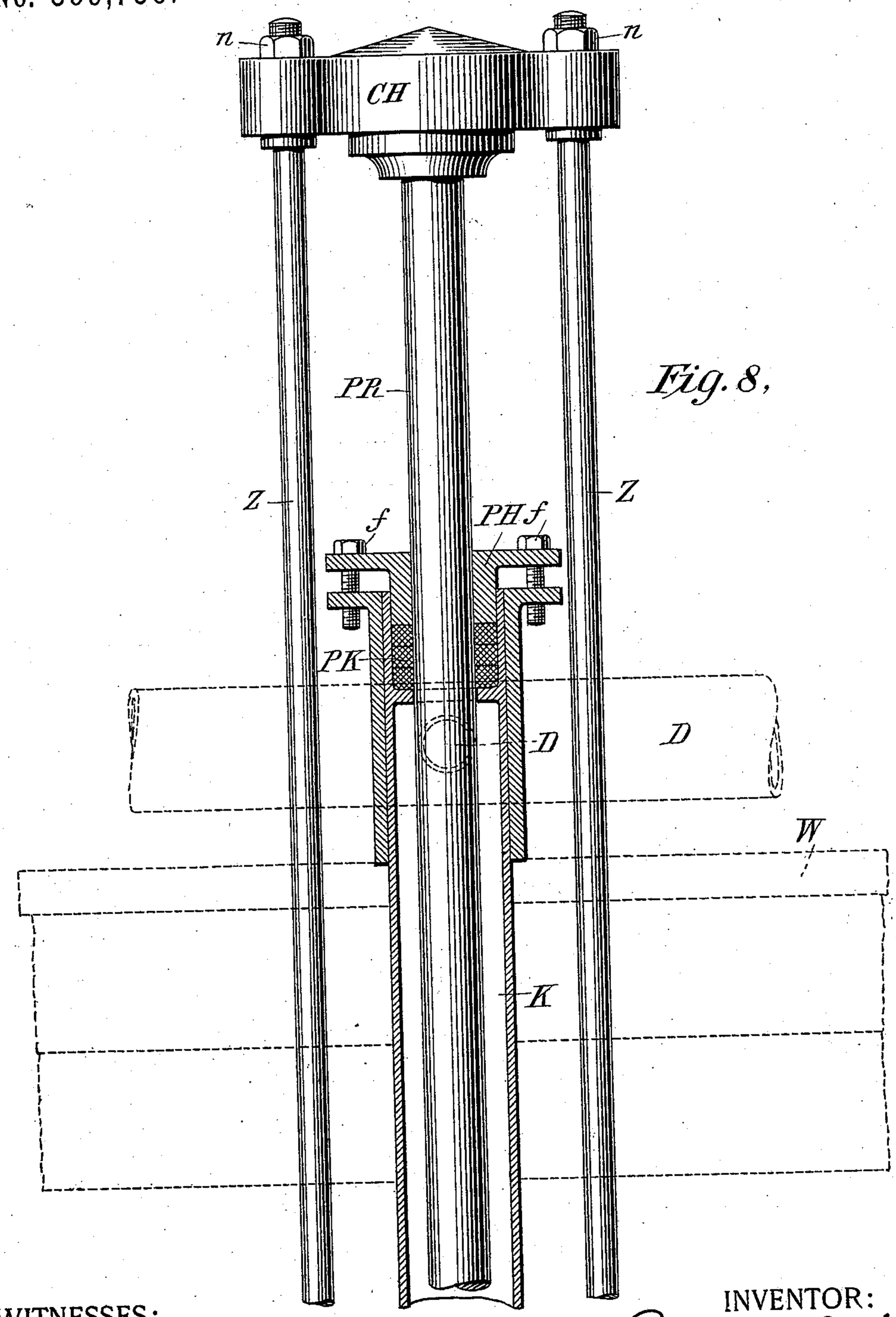

Fig. 8.

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UNITED STATES PATENT OFFICE.

PARVIN WRIGHT, OF LOS ANGELES, CALIFORNIA.

WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 599,756, dated March 1, 1898.

Application filed July 28, 1897. Serial No. 646,173. (No model.) Patented in England September 7, 1897, No. 20,543.

To all whom it may concern:

Be it known that I, PARVIN WRIGHT, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have made a new and useful Invention in Wave-Motors, (for which a patent has been granted to myself and others in Great Britain bearing date of September 7, 1897, and numbered 20,543,) of which the following is a specification.

My invention is directed particularly to improvements in that type of wave-motors in which rising-and-falling floats are utilized—such, for instance, as is disclosed in a prior patent granted to me on the 7th day of September, 1897, and numbered 589,520; and its objects are, first, to provide a wave-motor adapted for use in connection with large power plants where it is desired to utilize comparatively large areas of ocean-surface with a minimum amount of wharf structure; second, to devise a wave-motor which will utilize the power developed by a number of independent floats and in such manner that the same may be used under all conditions of wind and tide and still develop power at a substantially constant head or pressure; third, to so devise a wave-motor of the type indicated that any or all of the floats may during severe storms be disconnected from the plant and so arranged that it or they will not be damaged by the severity of such storms; fourth, to devise a wave-motor with a number of independent floats so interconnected with a common pressure-regulating mechanism that each float will operate independent of the others and the total energy developed thereby will be delivered to the translating devices or mechanisms utilizing the same at a substantially constant rate of supply or pressure; fifth, to provide pressure-regulating mechanism for a multiple-float wave-motor of the type indicated which shall enable the engineer or attendant to regulate at will the pressure exerted by any part of the apparatus, and, sixth, to support each float upon a hollow or tubular piling properly anchored and constituting not only a support, but at the same time the pumping-cylinder of an individual pump, the piston of which is operated by the float which it supports.

For a full and exact understanding of my invention, such as will enable others skilled in the art to which it relates to construct and use the same, reference is had to the following specification and particularly to the claims at the end thereof, in which the features of novelty are especially pointed out, and reference is also had to the accompanying drawings, in which—

Figure 1 illustrates in part sectional part side elevational view a single-float wave-motor embodying one form of my invention and the inclosing power-house, all supported upon piles anchored in the bottom of the ocean. Fig. 2 illustrates a similar view of the power-house and the mechanism in connection therewith supported partly upon shore and partly upon piles, the pumping mechanism not being shown in this view. Fig. 3 illustrates in plan view a complete system embodying my preferred form of apparatus, illustrating also its application to a system of electrical generation. Fig. 4 is a sectional view taken on the line *x x*, Fig. 3, and as seen looking at that figure from the bottom toward the top of the drawing in the direction of the arrows, the floats, their supporting-piles, and the pumping mechanism being shown in side elevational view. Fig. 5 is a transverse sectional view taken on the line *y y*, Fig. 3, and as seen looking at that figure of the drawings from right to left in the direction of the arrows, the floats being seen in front elevational view and one of the sustaining tubular piles being shown in part sectional view. Fig. 6 is an enlarged detail side elevational view of one of the floats and its attachments, a part of the float being broken away to show the interior structure thereof and also its roller-bearing supports upon the tubular pile which sustains it. Fig. 7 is a transverse sectional view of one of the tubular float-sustaining piles and a plan view of the float and its roller-bearings in connection therewith. Fig. 8 is a vertical sectional view of the upper end of one of the tubular sustaining-piles, illustrating also in side elevational view the pumping-piston and the connecting-rods between the cross-head at the upper end of said piston and one of the floats.

In the apparatus disclosed in my prior patent above referred to I have described and claimed a particular form of float in

which the outer surface exposed to the incoming waves is inclined downward, while the upper surface is similarly inclined, the first-named inclination being designed to utilize the lifting effects of the incoming waves and the second to quickly dissipate any water which may break over the surface of the float. This type of float is preferred by me, and is hereinafter described in connection with the other details of construction; but no claim is herein made to the same, as that constitutes in part the subject-matter of the claims of the before-mentioned patent. The aforesaid patent also discloses such a float pivotally connected by levers to standards or supports on shore and operatively connected with a vertically-moving rod connected in turn through adjustable clutch mechanism with a pump which, through the action of the rising and falling of the float, continuously pumps water from a tank into a compression-chamber, the same being utilized to drive a Pelton water-wheel and returning again to the before-mentioned tank.

It was with a view of improving upon the invention disclosed in the before-mentioned patent that the present apparatus in its entirety was devised.

Referring now to the drawings in detail, in all of which like letters of reference represent like parts wherever used, and first to Fig. 1, which represents one form of my improved apparatus, K′ K′ K′ represent piles secured in the bottom of the ocean by wedges to heavy metallic anchor-disks A D A D, as shown. Upon the upper end of these piles is built a power-house A, covering the operative parts of the mechanism excepting the float U, which is provided with vertical standards S′ S′, connected pivotally to levers L L′ by pivot-pins p' p', which levers are in turn pivotally secured to the inner piling K′ by pivot-pins p p, said float and its pivotal arrangement being substantially like that disclosed in my prior patent above referred to. Near the middle of the lever L is pivotally secured a rod R, the upper end of which is connected to a cross-head C H, adapted to move vertically in opposite directions the piston P′ of a pump P, firmly secured to the piles K′ K′. This pump P is connected by a pipe and a check-valve chamber C V at the upper end of a suction-pipe S, the free end of which extends to the bottom of a water-tank D T, containing a supply of water. The check-valve chamber C V is provided with two check-valves of the ordinary type, such that during the upward movement of the cross-head C H the pump will draw water into the cylinder P, and during its downward movement will force the water forward through a pipe D into a compression-tank T, connected in turn by a second pipe D^2 to a nozzle N, designed to drive a Pelton water-wheel W. H′ V′ is a hand-valve for controlling the operation of the float, and H V a second hand-valve in the pipe D^2 for controlling the supply of water to be delivered to the Pelton water-wheel or other water-motor W. The operation of this form of the apparatus is as follows: The hand-valve H V is normally closed and the hand-valve H′ V′ is then opened. As the float U rises through the action of the incoming waves upon the outer inclined surface F the lever L causes the rod R to lift the piston of the pump P through the agency of the cross-head C H and thereby draw a supply of water from the chamber D T into said pump. As the float descends, therefore, the lower check-valve in the chamber C V will be closed and the upper one opened, thereby forcing water through the pipe D into the compression-chamber T. The float will gradually descend until the next wave approaches, when it will in like manner be lifted and the operation repeated. This operation is continued until the pressure in the tank T becomes sufficient to hold the float in its upper position or until the desired pressure is reached, as indicated by any well-known form of pressure-gage upon the tank T. The hand-valve H V is now opened and the water allowed to flow through the pipe D^2 to nozzle N to the water-wheel W. Owing to the expansive nature of the air in the compression-chamber T, the rate of flow of water through the pipe D^2 and nozzle N will be comparatively constant, no matter what may be the action of the float as operated by waves of either long or short intervals. When it is desired to elevate the float U out of action during severe storms, the hand-valve H′ V′ is closed by the engineer when the float reaches its highest altitude, thereby causing it (the float) to be held suspended in the air by the action of the pump upon the water confined in the check-valve chamber C V. It will be understood, of course, that the parts of the pump P and the piping and attachments between it and the hand-valve H′ V′ should be of such strength and so proportioned with relation to the float U that they will withstand at all times without injury the pressure due to said float when sustained in the air. I prefer to fill the float U partially with water and to so arrange it that when it (the float) is held in its upper position this water may be quickly drawn off. This may be effected by openings in the bottoms of the floats, one of such openings being shown in Fig. 6 of the drawings, where Q represents a short section of pipe extending through the bottom of the float, the arrangement being such that as the float rests upon the surface of the water it will gradually sink until the air compressed in the upper and right-hand portion thereof will maintain it in a floating position, and also such that when the float is lifted out of the water, as hereinafter described, the contained water will flow out through said opening or openings, such an arrangement being designed for the purpose of utilizing the weight of the water in addition to that of the float. This form of struc-

ture is adapted for use in positions where piling may be readily located or in positions adjacent to bluffs, where the levers L and L′ may be pivotally connected to a permanent structure on shore.

Where it is desired to make a structure having large capacity and extending over relatively large areas of ocean-surface, I prefer the structure disclosed in Figs. 2 to 8, inclusive, which I shall now proceed to describe.

In Fig. 2 of the drawings is shown a power-house A, located on shore and closely adjacent to a sea-wall S W, K′ K′ being ordinary iron piles adapted to sustain at their upper ends by cross-timbers G and longitudinal beams O the flooring W, near shore. A series of tubular piles K K K, located farther seaward, sustain the outer portion of said structure and act also as individual supports for vertically-moving floats U U′ U², said piles being anchored by anchor-disks A D, as before, in the bed of the ocean and firmly secured together at their upper ends by girders E E E and tie-rods R R R, provided with turnbuckles T B T B, in a manner well understood by those versed in engineering structures and as clearly shown in Figs. 4 and 5 of the drawings, the arrangement being such that the entire structure possesses great strength.

D T is the water-tank, located in the basement of the power-house A and having sufficient capacity to fill all of the outlying water-pipes and the compression-chambers when acting at full load.

S is the main suction-pipe, running from the bottom of the tank D T downward and seaward beneath the entire wharf structure, said pipe branching or radiating and decreasing in size in its branches, there being ultimately one special branch pipe for each float U, U′, or U² and pump connected thereto, as clearly shown in Figs. 3 and 4.

T is a compression-chamber located, preferably, at a point near the power-house A and connected at one end by a delivery-pipe D, which runs seaward above the flooring W of the structure and has branches in all respects similar to the branches of the suction-pipe S. In other words, said delivery-pipe is provided with a branch running to the pump of each individual float.

D′ is a second delivery-pipe running from the shoreward end of the compression-chamber T to the bottom of a distribution-chamber T′, and D² D² D² a series of delivery-pipes (see Fig. 4) running from said distribution-chamber to four individual nozzles N N N N, adapted to supply water to four individual Pelton water-wheels connected to a common shaft, which shaft in turn is connected to the armature of a dynamo-electric machine D M, having its poles connected by conductors *w w* with the primary of a converter C V, the secondary of which is connected by conductors *w′ w′* to a switchboard S B, designed to furnish current to consumers through conducting leads or mains w^2 w^2. w^3 w^3 are similar conductors running to an electric motor E M, designed to operate an air-pump A P, which supplies air under pressure through a pipe *t* to an air-compression chamber T².

H V H V H V are hand-valves located in the pipes D² for regulating the flow of water to the water-wheels W.

H′ V′ is an additional hand-valve located between the compression-chamber T and the distribution-chamber T′ for regulating the flow between said chambers.

H² V² H² V² H² V², &c., are similar hand-valves located in the various radiating branches of the delivery-pipe D for varying at will the supply of water from any or all of the pumps.

t′ is an air-pipe running from the air-compression chamber T² to the compression-chamber T and having radiating branches running to the several air-chambers and pump-cylinders throughout the system, *h v h v h v* being hand-valves for regulating the flow of air into the various parts of the system in accordance with the necessities of the case, the function of these parts being to restore any air which may escape from the compression-chambers and air-chambers and pump-cylinders of the system.

C K C K C K are double check-valves of well-known structure, one for each pump, located in the branch pipes S at points near the pumps, the seats of said valves being so arranged that the pressure of the water from the tank D T will unseat the lower valves as the pistons of the pumps move upward and that they will be seated as said pistons move downward, while the upper valves will be unseated and permit the passage of water into the compression-chamber T.

S P S P S P, &c., are shunt-pipes, one for each pump, running entirely around the double check-valves C K, and H⁴ V⁴ H⁴ V⁴ H⁴ V⁴, &c., are hand-valves located therein, (see Fig. 4,) the function of said shunt-pipes and hand-valves being to aid in the holding of the floats at their upper positions when desired.

T³ is an air-chamber located above and connected with the main delivery-pipe D, there being, preferably, a number of such air-chambers distributed throughout the system and similarly connected, but only one shown for the purpose of avoiding unnecessary complication of the drawings, the function of said chambers being to distribute the elastic medium, such as air, confined therein at various points throughout the system.

Referring now to Figs. 5, 6, 7, and 8 for a detailed description of the floats and pumping apparatus, U represents in side elevational view one of the floats, which is so constructed as to have an opening through its center of sufficient size to admit of its free up-and-down movement about the tubular pile K, as clearly shown in Fig. 7. R R are T-rails firmly secured on opposite sides to each of the tubular piles K and adapted to

act as guides or runways for guiding-rollers *r r r*, two of said rollers being secured to the float by vertical timbers H H and braces H′ H′ on one side, and a third at the free end of an elastic or yielding timber H^2, secured to the float and provided near its upper end with an adjustment-screw S K for regulating the pressure of its roller upon the rail and hence the adjustment of the entire float. Q Q Q are strong timbers secured to the body of the float U and securing in turn the lower ends of vertically-arranged rods Z Z, the upper ends of which are secured by nuts *n n* to a cross-head C H, attached to the upper end of a plunger piston-rod P R, extending downward through a packing-ring P H, secured by bolts *f f* to the upper end of the hollow or tubular pile K, P K being water and air tight packing of the usual form. This form of plunger-pump, in which the packing P K is all put in position from the exterior, affords a simple and efficient pump, which is rarely out of repair and in which the packing may be quickly and effectually put in place without disturbing any portion of the apparatus other than the packing-ring P H and bolts *f f*. The hollow or tubular pile K constitutes the pumping-cylinder of each pump, and its lower end is filled with cement C, as clearly indicated in Fig. 5. The upper end of the pile K is provided with an opening or outlet operatively connected by a junction-pipe with the chamber of the double check-valve C K, the arrangement being such that as the float rises and falls water is drawn from the suction-pipe S into the pumping-cylinder at the upper end of the pile K and then forced forward through discharge-pipe D and ultimately into the compression-chamber T through the main discharge-pipe, as will be more particularly described in connection with the description of the mode of operation. The pumping-chamber or pile K of each pump is also connected with the air-pressure tank T^2 by the multiple branch pipe *t′*, as is clearly shown in Figs. 3 and 4 of the drawings, the arrangement being such that air under pressure is admitted in the top of each pump-cylinder for the purpose of elevating the floats above the wave when the power is not needed during storms or for repairs. When the valve H^3 V^3 is opened again, this air is excluded from the cylinders as the pistons descend, the air thus excluded passing out of the cylinders by way of pipe D to any of the supply-tanks T^3, dispersing any water that may have accumulated therein, it being understood that the pressure in the air chamber or tank T^3 is usually much greater than that in any of the other chambers.

I will now describe the mode of operation of this preferred form of apparatus. (Illustrated in Figs. 2 to 8, inclusive.) Upon the supposition that the apparatus is to be started anew it will be understood that all of the water is in the tank D T, the suction-pipes S, and pump-cylinders K. The hand-valves H V in the discharge-pipes D^2 D^2 D^2 are closed, and the hand-valves H′ V′ H^2 V^2 H^2 V^2, &c., H^3 V^3 H^3 V^3, &c., are all opened, while the hand-valves H^4 V^4 H^4 V^4, &c., in the shunt-pipes S P S P, &c., and the additional hand-valves *h v h v h v*, &c., in the air-supply pipes *t′* are all closed. Under this condition of affairs the incoming waves W A will strike the first series of floats U^2, (see Fig. 4,) thereby lifting the same. Consequently the plunger-piston rods P R are elevated, and as they are elevated the water flows into the pump-cylinders K out the suction-pipes S. As the wave passes forward to the next succeeding series of floats U′ they are elevated in a like manner, and the first series of floats are now left free to descend by their own weight. In so descending the valves in the check-valve C K act in a manner well understood to cut off the supply of water from the suction-pipes and to allow the water in the delivery-pipes to be forced forward into the main pipes and ultimately into the compression-chamber T. The next set of floats now descends, and the third set U is lifted in like manner, the action taking place simultaneously or dissimultaneously, in accordance with the condition or peculiarity of the waves by which they (the floats) are actuated, each float being absolutely independent in its action of every other float, its pumping action correspondingly independent, and the total effect such as to force the water continuously forward through the system of delivery-pipes D into the compression-chamber T, where the air in the upper portion of said chamber is necessarily highly compressed. When the pressure-gage upon the compression-chamber T indicates the desired pressure, the hand-valve H′ V′ is opened and the water in said compression-chamber allowed to flow forward through the pipe D′ into the distribution-chamber T′ and from thence into the delivery-pipes D^2 D^2 D^2 D^2, where it is held in check by the hand-valves H V H V H V. These valves are opened after the pressure-indicator upon the distribution-chamber indicates the necessary pressure, and the water is allowed to flow upon the buckets of the Pelton water-wheels W, thereby setting in motion the armature of the dynamo D M and generating the necessary current through the primaries of the converters C V and the secondaries thereof to the working circuits w^2 w^2. The current now set up in the conductors w^3 w^3 sets in motion the electric motor E M, which in turn puts in motion the air-pump A P, and the hand-valve *h v* in the pipe *t* having been turned to the proper position air is now compressed in the air-chamber T^2 to the desired degree, as will be indicated by the pressure-indicator thereof. As the operation continues the engineer or attendant may now regulate the pressure of air in the compression-chamber T and in all of the air-chambers T^3 located above the system of delivery-pipes by turning the proper hand-valves *h v* and

supplying air to any of said chambers or to the upper portions of the pump-cylinders K′, these matters being entirely within his control by virtue of the independent hand-valves *h v h v*, &c., it being understood that there is provided with each of said chambers the necessary water-gages for indicating the height of the water therein. Should the attendant fail to turn the hand-valve H′ V′, the pumps will of course continue to pump water into the compression-chamber T until the pressure reaches such a height that the back pressure will maintain the floats in an elevated position approximating the tops of the highest waves over which they ride; but this will not cause serious inconvenience of the system by virtue of the fact that each plunger-pump is connected with the air-chambers T and T^3, the elasticity of which is sufficient to maintain the entire system intact from wrecking influences. As a means of controlling individually the lifting of any float entirely out of the reach of the waves, the hand-valve H^3 V^3 is closed and the hand-valve H^4 V^4 in the relatively small shunt-pipe S P opened, thereby establishing a back pressure of water from the delivery-pipes D into the pump, tending to slowly lift the plunger thereof and at the same time the float. As the float is thus lifted the water therein is released, thereby materially lightening it, so that ultimately the back pressure is sufficient to lift it to its extreme limit, where it may be held by the water confined in the cylinder and secured by ropes or otherwise to the upper portion of the framework. Such an arrangement makes it possible to lift all of the floats entirely free of the water after the pressure has reached the maximum in the compression-tank T, pressure-pipes D, and air-chambers T^3, a feature of very great importance in the event of storms and destructive high tides.

I do not limit myself to the especial details of construction herein shown and described for effecting the results sought, as in this particular I believe it is broadly new with me to so connect a wave-motor float with mechanism that it will automatically lift itself out of the influence of the waves, and my claims in this particular are to be construed as of the most generic scope. I believe it is also new with me to combine a series of floats with a series of pumps and one or more compression-chambers in such manner that the combined variable effect of such floats and pump is converted into a substantially constant source of energy which may be utilized as such, and my claims are generic also as to this feature.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a wave-motor system a number of independent floats having independent movement and each operatively connected with a separate pump, in combination with a compression-chamber operatively connected with all of said pumps, said compression-chamber being in turn connected to a water-motor as a Pelton water-wheel and all acting substantially as and for the purpose described.

2. In a wave-motor system a number of floats having independent movement and each operatively connected with a pump, a water-tank connected by suction-pipes with all of said pumps, a compression-chamber connected by discharge-pipes with all of said pumps and a water-motor operatively connected in turn with said compression-chamber and adapted to discharge the water therefrom into said water-tank, all of said parts acting substantially as and for the purpose described.

3. A wave-motor consisting of a float operatively connected with a pump which in turn is connected by a discharge-pipe to a compression-chamber, in combination with means for controlling the backflow of water from the compression-chamber to the pumps and in such manner that the float may be elevated above or out of reach of the waves when desired, substantially as described.

4. A wave-motor consisting of a float operatively connected with a pump which in turn is connected by a discharge-pipe to a compression-chamber, a hand-valve for closing the discharge-pipe, in combination with a shunt-pipe shunting the valves of the pump, and a second hand-valve for controlling the flow of water therethrough, the arrangement being such that the backflow of water through the shunt-pipe from the compression-chamber will lift the float out of the reach of the waves, substantially as described.

5. In a wave-motor system a series of independent floats each operatively connected with an individual pump, a pipe operatively connecting a water-supply tank through branch pipes with said pumps, a series of discharge-pipes operatively connecting said pumps with a main discharge-pipe connected in turn to a compression-chamber, a hand-valve for each pump adapted to regulate the flow of water therethrough into its corresponding discharge-pipe, a shunt-pipe shunting the valves of each pump and a hand-valve located in each shunt-pipe, in combination with a discharge-pipe running from the compression-chamber to a water-motor which in turn discharges the water into the aforesaid water-tank, the arrangement being such that all of said floats may be operated or any or all of them lifted out of the reach of the waves, substantially as described.

6. In a wave-motor system a series of independent floats operatively connected each with an individual pump, said pumps being provided with suction and discharge pipes, in combination with a compression-chamber operatively connected with a main discharge-pipe and an air-compression chamber provided with means for compressing air, said air-compression chamber being interconnected with the different parts of the apparatus so as to constitute a pressure-regulating mech-

anism therefor, all of said parts acting substantially as and for the purpose described.

7. A wave-motor system provided with a series of independent floats operatively connected with pumping mechanism, in combination with a pressure-regulating apparatus adapted to supply air under pressure to the different parts of the system, together with a water-motor operatively connected to a compression-chamber into which water is pumped by the united action of all of the pumps, all of said parts acting substantially as and for the purpose set forth.

8. A wave-motor system consisting of a series of floats each operatively connected with an individual pump, a series of suction and discharge pipes connected to said pumps, a compression-chamber connected to said discharge-pipes and a distribution-chamber connected to said compression-chamber, in combination with a series of discharge-pipes and a series of Pelton water-wheels adapted to receive water from said discharge-pipes, together with a water-tank adapted to supply water to the suction-pipes and to receive the discharged water from the water-wheels, all of said parts acting substantially as and for the purpose described.

9. In a wave-motor a tubular pile, the upper end of which constitutes a pump-cylinder, its bottom end being closed to form a cylinder-head and the top end provided with a detachable packing-ring and packing, in combination with a reciprocating plunger-piston, substantially as described.

10. In a wave-motor a tubular pile the upper end of which constitutes a pump-cylinder, its bottom end being closed to form a cylinder-head and the top end provided with a detachable packing-ring and packing, in combination with a reciprocating piston operatively connected by a cross-head to a pair of rods which in turn are secured to a float surrounding the pile, all of said parts acting substantially as described.

11. In a wave-motor a wharf structure consisting of a series of tubular piles secured together at their upper ends, said tubes constituting the cylinders of a series of pumps, the top ends being provided with removable packing-rings and packing adapted to receive reciprocating plunger-pistons operatively connected with floats which surround the piles, substantially as and for the purpose described.

12. In a wave-motor a series of vertically-arranged pumping-cylinders secured together at their upper ends and to the bottom of the ocean and supporting the mechanism of a pumping plant, in combination with a series of floats having each an inclined outer face adapted to receive the force of incoming waves and an inclined top surface adapted to shed or dissipate any overflowing water, together with means for guiding it in its vertical movement, substantially as described.

13. In a wave-motor a vertical tubular pump-cylinder secured at its lower end in the ocean-bed and supporting pumping mechanism at its upper end, in combination with a float surrounding said pumping-cylinder, said float having an inclined outer face adapted to receive the force of incoming waves and an inclined top surface adapted to shed or dissipate any overflowing water, together with means for guiding said float in its vertical movement, substantially as described.

14. In a wave-motor system two or more tubular piles, which constitute cylinders of independent pumps, a wave motor or float for each pump, in combination with pipe connections between said pumps and a compression-chamber, all of said parts acting substantially as and for the purpose described.

15. In a wave-motor system two or more independent floats operatively connected to force-pumps, said pumps being in turn connected to a pressure tank or tanks, in combination with a supplemental air-tank having circulating-pipes operatively connected with air-chambers and a compression-chamber and means for supplying air under pressure, substantially as described.

16. In a wave-motor a tubular pile the upper end of which constitutes a pump-cylinder, the bottom end thereof being closed to form a cylinder-head and the top end provided with a detachable packing-ring, in combination with a plunger-piston operatively connected with a float which surrounds the tubular pile and is provided with guide-wheels adapted to guide the float in its vertical movement upon rails secured to the pile, all of said parts acting substantially as described.

17. In a wave-motor a tubular pile the upper end of which constitutes a pump-cylinder and is provided with a detachable packing-ring having packing therefor, in combination with a plunger-piston adapted to reciprocate through said packing-ring, said piston being operatively connected to a float which surrounds the tubular pile and is provided with guide-rollers having means for adjusting said rollers relative to their supports upon the pile, substantially as described.

In testimony whereof I have hereunto subscribed my name this 1st day of May, 1897.

PARVIN WRIGHT.

Witnesses:
SHIRLEY C. WARD,
ST. GEORGE T. C. BRYAN.