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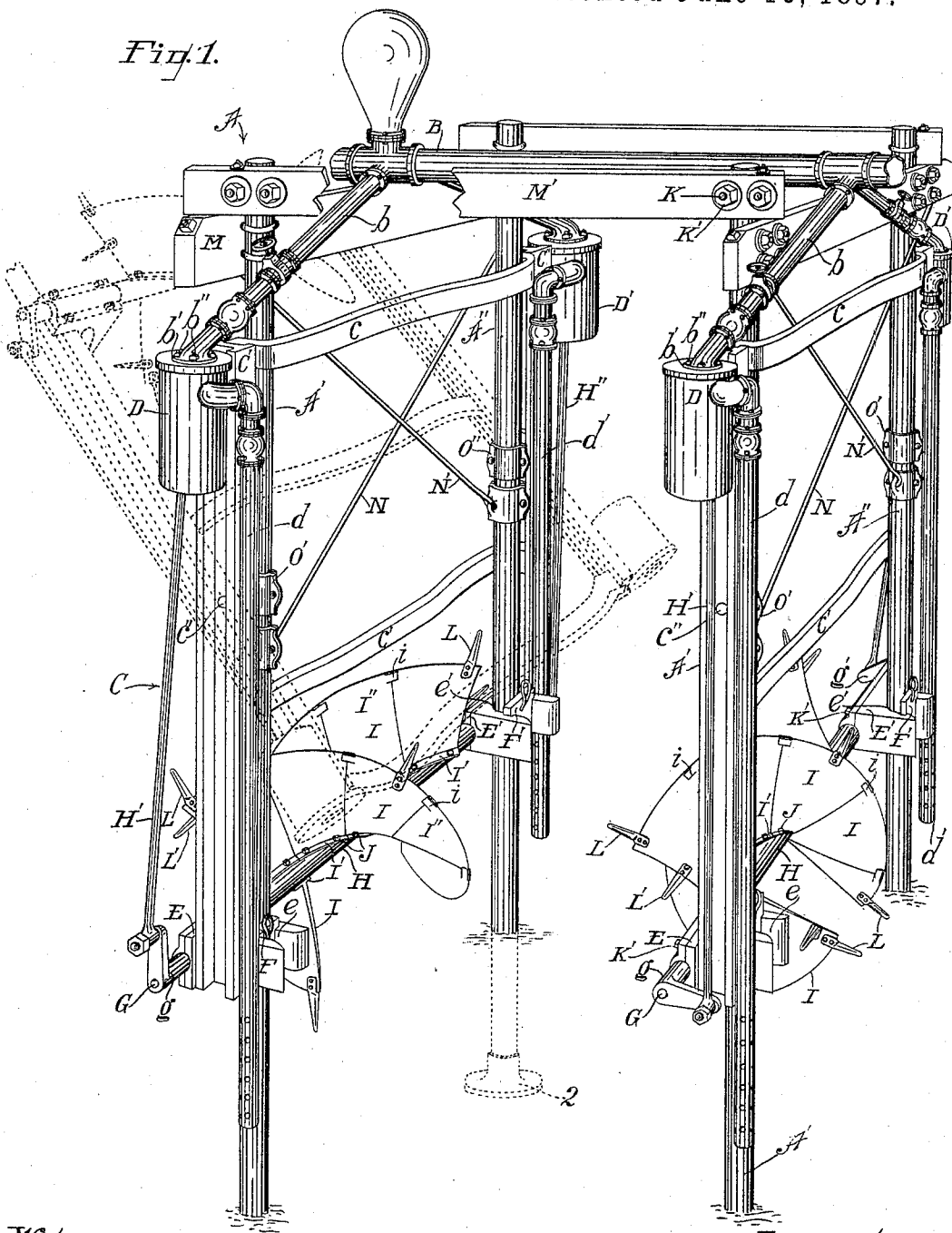
3 Sheets—Sheet 1.

W. S. SCHUYLER.  
OCEAN POWER.

No. 584,412.

Patented June 15, 1897.

Fig. 1.



Witnesses

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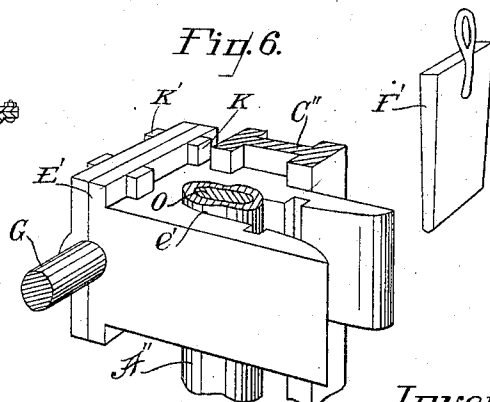
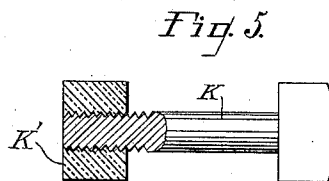
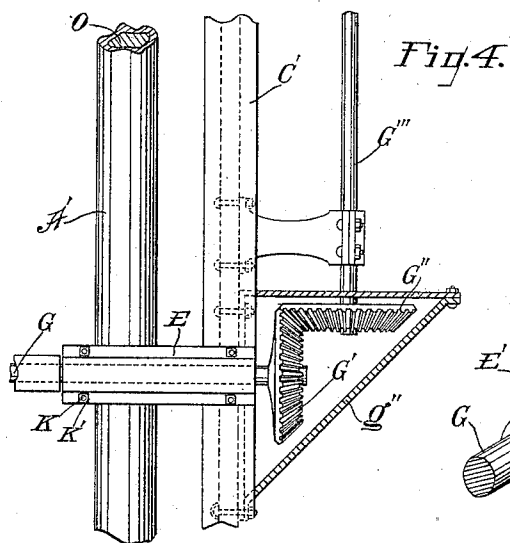
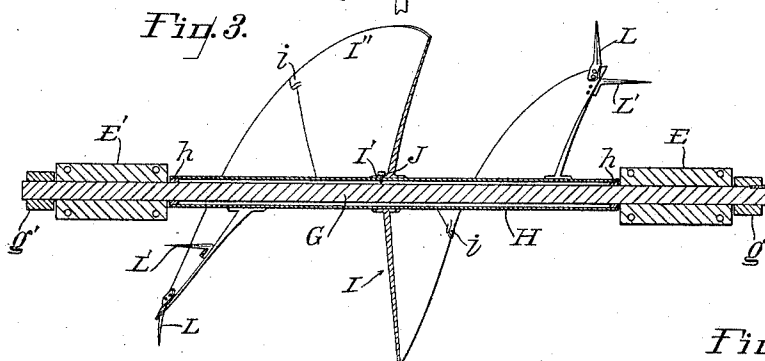
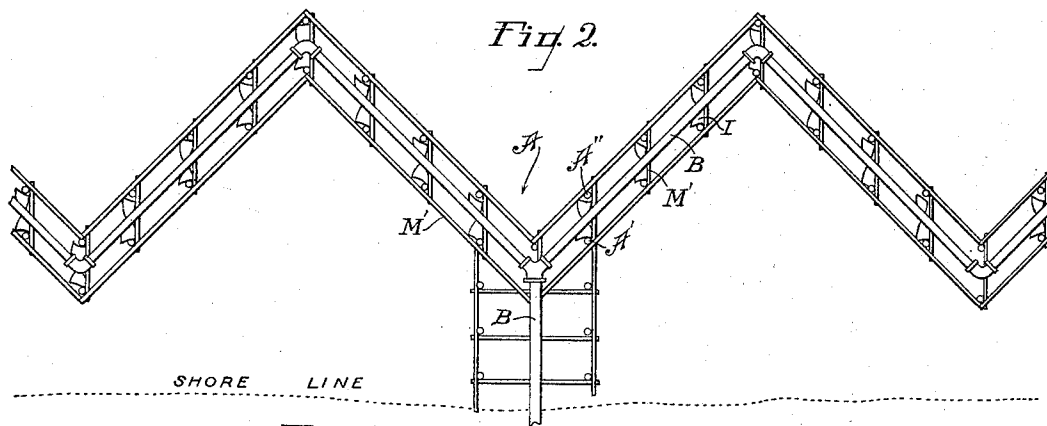
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3 Sheets—Sheet 2.

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3 Sheets—Sheet 3.

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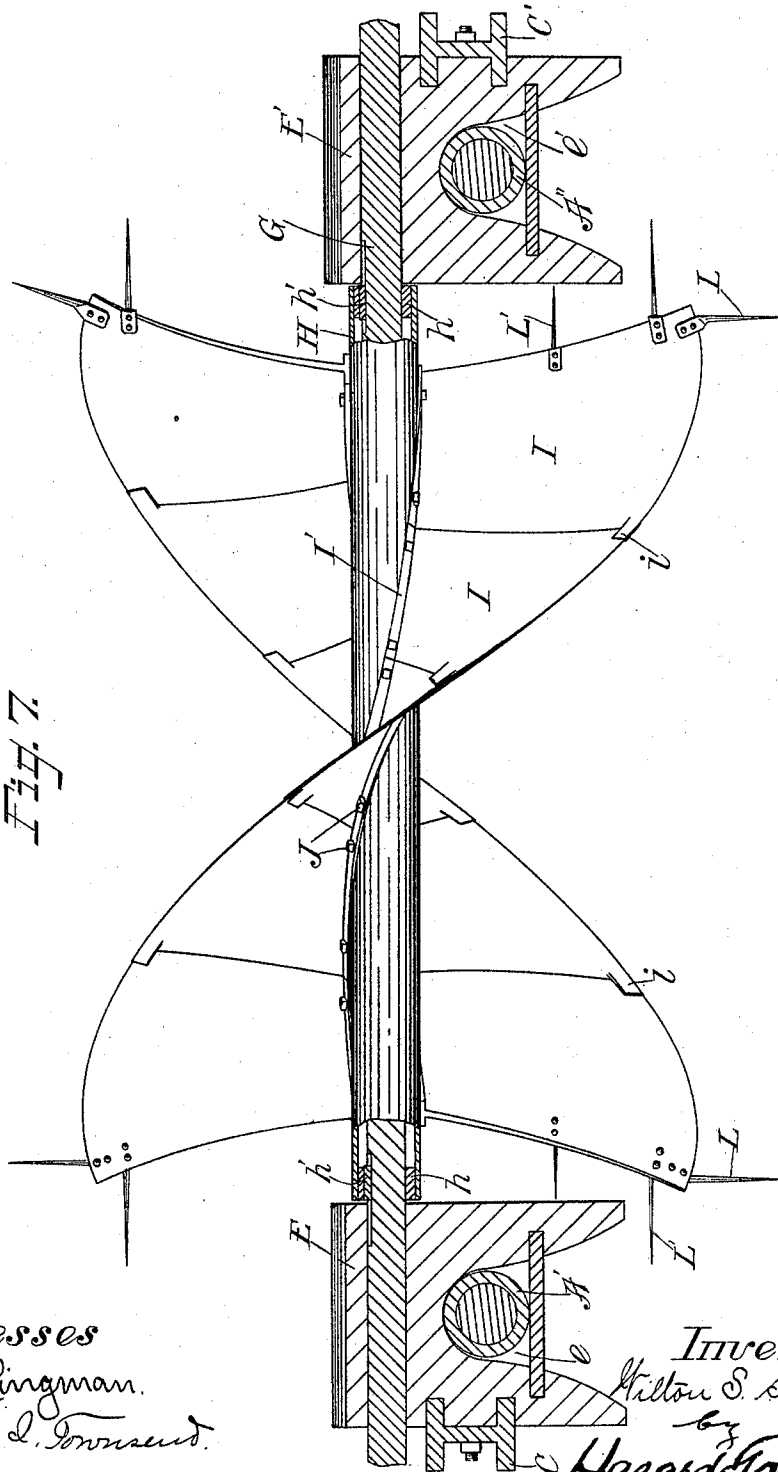


Fig. 7.

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# UNITED STATES PATENT OFFICE.

WILTON SUMNER SCHUYLER, OF OCEANSIDE, CALIFORNIA.

## OCEAN-POWER.

SPECIFICATION forming part of Letters Patent No. 584,412, dated June 15, 1897.

Application filed June 9, 1896. Serial No. 594,885. (No model.)

*To all whom it may concern:*

Be it known that I, WILTON SUMNER SCHUYLER, a citizen of the United States, residing at Oceanside, in the county of San Diego and State of California, have invented new and useful Improvements in Ocean-Powers, of which the following is a specification.

Many attempts have heretofore been made to utilize successfully the power of the tides and waves of the ocean. So far as I am aware such attempts have been only partially successful. It must be understood that there are many factors which must be considered if one is to make successful use of ocean-power. For instance, the means for utilizing the power must be cheap and extremely simple and durable, must be conveniently arranged, so that in case of breakage repairs can be quickly and cheaply made, and the parts must be so put together as to be readily taken apart, the action of salt water upon most metals being such that the parts soon become so rusted as to prevent the removal of bolts, &c. In addition to this the device for utilizing the ocean-power must be so arranged as to utilize a large percentage of power, but will allow heavy breakers and swells to pass by without offering such resistance as to cause the force of the breakers to destroy the machine.

One object of my invention is to provide a simple and efficient device which will utilize the force of the inflowing breakers and will also utilize the force of the undertow.

A further object of my invention is to provide a device for utilizing ocean-power which can be readily removed from the water for repairs in case of breakage and can as readily be replaced therein when desired. Incidentally, in case at any time it is not desired to utilize the power my improved device can be removed from the water until such time as it is desired to again utilize the power.

A further object of my invention is to provide improved means for fastening together the parts of an ocean-power, or, in fact, securing together the parts of any structure which is subject to the action of salt water in such a manner as to prevent rusting of the nuts upon the bolts.

A further object of my invention is to pro-

vide an improved ocean-power which will avoid all liability of entanglement of seaweed with the power-converting device.

My invention comprises the peculiar shape of structure which I employ for supporting the power-converting appliances in such relation with each other that they will be acted upon in regular succession by each breaker, thus to secure practically continuous operation of the various devices—that is to say, that at all times at least a portion of the power-converting devices will be in operation.

My invention also comprises the various features of construction and combinations of parts whereby I secure superior convenience of operation, durability, and ease of manipulation.

The accompanying drawings illustrate my invention.

Figure 1 is a fragmental front elevation of two sets of piles each provided with one of my improved power-converting mechanisms. Fig. 2 is a plan view of a structure built according to my invention and having supported thereby series of my improved ocean-power-converting mechanisms. Fig. 3 is a longitudinal section of one of the power-shafts and the screw carried thereby. Fig. 4 is a fragmental view showing another manner of conveying power from the power-shaft. Fig. 5 is a sectional view of one of my improved bolts for securing together parts exposed to the action of salt water. Fig. 6 is a fragmental perspective view showing one of the journals for the power-shaft and illustrating the way in which I lock the frame to the piles. In this view the gate is removed from its locking position. Fig. 7 is a fragmental view, partly in section, looking down upon the screw and showing the manner of keying the sleeve to the shaft and also illustrating the manner of securing the frame to the piles.

In the drawings, A represents in general terms my improved structure for supporting my ocean-power-converting apparatus. This structure is composed of series of pairs of piles A' and A'', each pair being arranged at right angles to the shore, and the series of pairs of piles being arranged out of line with each other to form a zigzag or step-like structure, as shown in Fig. 2. Upon the top of this

structure I arrange a water-main B, through which is pumped water by means of my power-converting apparatus.

To each set of piles is pivoted by pivots  $c''$  5 a tilting frame C. These frames are each composed of two uprights  $C'$  and  $C''$ , pivoted, respectively, upon the outer sides of the piles  $A'$  and  $A''$ . These uprights are connected with each other by means of cross-beams  $c c'$ , 10 one arranged above and the other arranged below the pivotal point of the uprights and upon opposite sides of the pile, so that the frame can swing without the cross-beams being brought into engagement with the piles. 15 To the upper end of each upright is rigidly secured a pump D D', respectively, and to each upright is also secured a suction-pipe  $d d'$ , which respectively lead to the pumps. The water-main B is detachably connected with 20 each pump by means of a branch pipe  $b$ , which is secured to the top of the pump by a flanged coupling  $b'$ , through which pass cap-screws  $b''$ , which are screwed into the head of the pump-cylinder. 25 To the lower end of each upright is secured a journal-box E E', respectively. These journal-boxes are each provided with a U-shaped seat  $e e'$ , respectively arranged to seat the piles therein. The entrance to each seat is 30 closed by means of a gate F (F'), in order to prevent the removal of the journals from the piles when it is desired to hold the frame rigid with relation to the piles. In these journal-boxes is journaled a shaft G, which is provided upon each end with a crank-arm  $g g'$ , 35 respectively, and upon these crank-arms are journaled connecting-rods H' H'', which are respectively connected with the pistons of the pumps D D'. Upon this shaft is arranged a 40 sleeve H, which has an internal diameter greater than the diameter of the shaft, and at each end of the sleeve I arrange a head  $h$ , which is provided with an opening of the same diameter as the shaft. The sleeve fits 45 upon the shaft between the two journal-bearings E E' and serves to take the end thrust of the screw.

Upon the sleeve I secure series of wings I, which are duplicates of each other. Each 50 wing comprises a base I', arranged to fit upon the sleeve H, which forms the body of the screw, and a body I'', which is provided upon one edge near its outer end with projecting 55 lugs or prongs  $i$ , arranged to form a seat to receive and seat between them the edge of the adjoining section or wing. These wings are secured to the sleeve H by means of cap-screws J, which pass through the flanges I' and into screw-threaded openings provided 60 in the sleeve. By reason of the sleeve being of greater diameter than the shaft, the ends of the cap-screws may project inside the sleeve a sufficient distance to allow for any inequality in the thickness of parts. Furthermore, 65 the sleeve gives a large surface for the base of the wings to rest upon and avoids excessive

weight and weakening the shaft by drilling the holes to receive the cap-screws.

In Fig. 4 I have shown a bevel cog-wheel  $G'$ , secured upon the end of the shaft G, and 70 a bevel cog-wheel  $G''$ , secured upon a shaft  $G'''$ , whereby power may be conveyed from the screw. The bevel-gear is protected from seaweed, sand, &c., by means of a casing  $g''$ .

One very great difficulty to be overcome 75 in providing a successful ocean-power is the tendency of the parts to rust together, so that after a machine has remained in salt water for a few months it becomes practically impossible to remove the nuts from the bolts. 80 If the nuts are removed, the bolts and nuts are so rusted that they can very seldom be used a second time. Ordinarily they are so firmly rusted together that the nut must be split in order to remove it from the bolt, and 85 in doing this oftentimes the bolt is injured so that it cannot again be used even with a new nut. I have invented and discovered means whereby I overcome the tendency of 90 the nuts to rust upon the bolts and have produced a device whereby parts which are subjected to the action of salt water can be secured together and be afterward taken apart without any difficulty whatever and without 95 destroying either the nut or the bolt. This feature of my invention is illustrated in Fig. 5, and comprises a steel bolt K and a nut K', formed of alloyed copper. This alloy may be either phosphor-bronze or brass having a large percentage of copper therein. In case 100 brass is used there should be just sufficient zinc placed with the copper to harden the brass so that the threads will not strip.

I prefer to make the nut longer than the ordinary steel machine-nut in order to secure 105 with the weaker metals the same strength which is customary in steel nuts.

It is essential to the most perfect practice of this feature of my invention that the screw-threaded end of the steel bolt does not project 110 beyond the nut. If it does, the exposed end of the bolt will become so rusted as to interfere with the removal of the nut. I have found in practice that even after long usage in salt water the nut may be removed from 115 my improved bolt with perfect ease and that the threads are not in any manner rusted or injured.

In many places along the Pacific coast there are large beds of kelp or seaweed which become torn loose and are washed into shore. 120 They would interfere materially with the operation of a screw, and I therefore provide means for preventing such seaweed from becoming entangled with the screws of my 125 ocean-power. This means consists of a series of knives L, secured to the periphery of the wings of the screw, and each having its width arranged in line with its line of motion, as clearly shown in Fig. 1. These knives 130 are preferably two-edged, so that they will cut the seaweed when the screw is revolving

in either direction. I also secure knives L' upon the front and rear end of the screw, so as to cut any weed which may not float into the path of the other knives.

5 In building my improved structure I propose to employ for the piles metallic pipes of from four to six inches in diameter. These pipes are each provided on the bottom with large cast-iron flanges Q, as indicated in dotted lines in Fig. 1. They are sunk into place by forcing water down through the pipe and flange, and thus displacing the sand and allowing the flange and the pile to settle down into the sand. When the pile has sunk to 15 the required depth, the flow of water is stopped and the sand packs down around the flange, thus preventing the removal of the pile by the lifting force of the waves. The flange furnishes a large base which prevents the pile 20 from settling any deeper. The water may be pumped from the inside of the pile and the pipe filled with concrete O, as shown in Fig. 6, thereby to prevent the action of salt water upon the inside of the pile. The tops 25 of the piles are then connected with each other by cross-pieces M M', and are braced by means of suitable tie-rods N and N'. Then the uprights C' C'' are pivoted to the piles by means of the pivot-clips O' O'', the cross-pieces c c' are bolted to the uprights, and the journal-boxes E E' are secured to the lower ends thereof. It will be understood that the uprights are turned into a horizontal position, as indicated by dotted lines in Fig. 1, 35 while the parts are being secured together, so that the mechanism is thus held out of the water. Then the shaft G, with the sleeve H in position thereupon, is placed in the journal-boxes E E', and the wings I are secured 40 to the sleeve.

If deemed preferable, the wings may be secured to the sleeve before placing the shaft in position in the journal-boxes. The sleeve is keyed to the shaft by means of keys h' in the 45 ordinary manner. The length of the sleeve is such that it engages with both journals of the shaft, thus to serve to take the end thrust of the screw in either direction. The pumps D D' are secured to the uprights, and the suction-pipes d d' are also secured to the uprights, and then the frame is tilted to thrust the screw down into the water, as indicated in solid lines in Fig. 1. The pumps are thus brought into position beneath the flanged ends b' of the branch discharge-pipes b, and such pipes are secured to the pumps by means of the cap-screws b'', which are screwed through the flanged ends of the pipe and into the end of the pump-cylinder. When the 60 frame is swung down, the seats e e' embrace the piles A' A'', and the gates F F' are inserted into their grooves to close the entrance to the pile-seats and to hold the frame rigid in its vertical position.

65 I design to build my structure so as to bring its mid-line substantially at the point at which the breakers comb between high and low tide.

As the breakers advance toward the shore they rotate the screws in one direction. Reverse movement either of the breakers or of 70 the undertow causes the screw to revolve in the opposite direction. By gearing direct from each shaft to the pump any motion, however slight and in either direction, is utilized to pump water from the ocean into the main 75 B, and from there it may be conveyed to an elevated reservoir, (not shown,) from which it may be drawn as desired and utilized by any suitable means for producing power from the fall of water. 80

If any seaweed comes floating in upon the screws, the knives cut it to pieces, so that it cannot become entangled with the screw or the working parts of the device. If from any accident the machine becomes broken, by de- 85 taching the branch discharge-pipes from the pumps and removing the gates F F' from their seats and then tilting the frame upon its pivots the screw can be brought above the water, as indicated in dotted lines in Fig. 1, and the 90 repairs can be conveniently made and without danger to the workmen.

By arranging the piles in pairs and in the form of a step-like structure and securing a power-converting device to each pair of piles 95 the power-converting devices, by reason of their step-like arrangement, are acted upon successively by the advancing breakers or the receding undertow, so that at all times a portion of the devices will be in operation to 100 pump water into the main; also, by my improved step-like arrangement of the support the action of the waves upon the structure will be diagonal to the various sections instead of broadside thereto, and therefore the 105 strain upon the structure will be greatly reduced; also, by supporting the screws by attaching the frame to the piles beneath the surface of the water the strain upon the structure is much less than is possible where the 110 power-converting devices are secured to the top of the structure.

By making the body of the screw very small and of uniform diameter throughout I adapt the screw for being acted upon by water flow- 115 ing in either direction; also, by leaving the screw unincased, no matter from what direction the breakers advance, they will operate to turn the screw and will always act upon a surface arranged at an oblique angle with the 120 line of motion of the breaker, so that the screw receives a glancing blow instead of a direct blow.

Now, having described my invention, what I claim as new, and desire to secure by Letters 125 Patent, is—

1. In an ocean-power, an unincased screw having a small body of uniform size throughout, and adapted for being rotated by water flowing in either direction; means for sup- 130 porting the screw in the water; and means for conveying power from the screw.

2. In an ocean-power, the combination of a shaft journaled to revolve; an unincased spi-

ral screw fixed to such shaft and adapted to be rotated by water flowing in either direction; and suitable means for conveying power from the shaft.

5 3. In an ocean-power, the combination of two journal-bearings; a sleeve having an internal diameter larger than the shaft, provided with heads having openings therein to receive the shaft and keyed thereto between  
10 the bearings; wings detachably secured to such sleeve and arranged to form a screw; and means for conveying power from the shaft.

4. In an ocean-power, the combination of two journal-bearings; a shaft journaled in  
15 such bearings and provided at each end with a crank; a sleeve having an internal diameter greater than the diameter of the shaft, provided with heads having openings to fit the shaft and fitted and keyed upon the shaft between the bearings; wings secured to such  
20 sleeve and arranged to form a screw; suitable pumps; and a connecting-rod attached to each crank and arranged to operate the pumps.

5. An ocean-power, comprising a support; a vertically-arranged swinging frame pivoted near its mid-length to the support; means for locking the frame to the support; a device for utilizing ocean-power secured to the lower end of the frame, the frame being adapted to  
30 partially rotate upon its pivot to lift the power device from, or to place it in the water.

6. An ocean-power, comprising a support; a vertically-swinging frame pivoted to the support; a pump fixed to the frame; a suction-pipe fixed to the frame and connected  
35 with the pump; a discharge-pipe detachably connected with the pump; a screw journaled to the lower end of the frame; suitable means connecting the screw with the pump; and  
40 suitable means for connecting and disconnecting the frame with the support to lock it against movement or to allow it to swing upon its pivot to lift the screw from, or to place it in the water.

7. In an ocean-power, the combination set forth of two piles; a vertically-swinging frame pivoted to the piles; pumps secured to the frame; suction-pipes secured to the frame and leading to the pumps; discharge-pipes detachably connected with the pumps; a shaft  
50 journaled to the lower end of the frame and provided at each end with a crank-arm; a screw secured to the shaft; connecting-rods journaled upon the crank-arms and arranged to operate the pumps; and suitable means for  
55 connecting and disconnecting the frame with the piles to lock the frame against movement or to allow it to swing to withdraw the screw from, or to place it in the water.

8. In an ocean-power, the combination of two piles; an upright pivoted upon the outside of each pile; braces connecting the two uprights and arranged on opposite sides of the piles, one above and one below the pivotal point of the uprights; a pump secured  
60 to the upper end of each upright; a suction-pipe carried by each upright and leading to

each pump; a journal-box carried by the lower end of each upright and provided with a seat adapted to seat its respective pile therein; a gate for closing the entrance to each pile-seat; a shaft journaled in the journal-boxes and provided at each end with a crank-arm; a connecting-rod connecting each crank-arm with its respective pump; and a screw secured to the shaft.

9. The device set forth for securing together parts subjected to the action of salt water, comprising a steel bolt and a nut of alloyed copper screwed upon such bolt.

10. In an ocean-power, a screw adapted to be rotated by the breakers and provided with projecting knives each having its width in line with its line of motion.

11. In an ocean-power, a screw adapted to be rotated in either direction by the breakers and provided with double-edged projecting knives each having its width in line with its line of motion, substantially as and for the purpose set forth.

12. In an ocean-power, the combination set forth of a screw-body; wings formed in sections each provided with a base adapted to fit upon the body of the screw and having upon one edge projecting prongs or lugs arranged to form a seat to receive the edge of the adjoining section; and suitable means for securing the sections to the body of the screw.

13. In an ocean-power, the combination of a shaft journaled to revolve; a sleeve having an internal diameter larger than the shaft, provided with heads having openings therein to receive the shaft and keyed thereto between the bearings; wings, each secured to the sleeve by cap-screws passing through the base of the wing and into the sleeve, the wings being arranged to form a screw; and suitable means for conveying power from the shaft.

14. An ocean-power, comprising series of pairs of piles arranged at right angles to the shore and to form a zigzag or step-like structure extending substantially parallel with the shore; a screw supported by and between each pair of piles; and suitable means for conveying power from the screws.

15. An ocean-power comprising series of pairs of piles arranged at right angles to the shore and to form a zigzag or step-like structure extending substantially parallel with the shore; a tilting frame pivoted to each pair of piles; a screw journaled to the lower end of each frame; and suitable means for conveying power from the screw.

16. An ocean-power, comprising series of pairs of piles arranged at right angles to the shore, and to form a zigzag or step-like structure extending substantially parallel with the shore; a tilting frame pivoted to each pair of piles; pumps carried by each frame; a water-main carried by the structure and detachably connected with each pump; a screw journaled to the lower end of each frame; and suitable means connecting each screw with the pumps carried by its respective frame.

17. An ocean-power, comprising two piles; a vertically-swinging frame pivoted to the piles and provided at the bottom with pile-seats arranged to seat upon the piles; pumps 5 secured to the frame; suction-pipes leading to the pumps; discharge-pipes connected with the pumps; a shaft journaled to the lower end of the frame; a screw secured upon the shaft; suitable means connecting the shaft 10 with the pumps; and suitable means for connecting the frame with the piles to hold the frame rigid.

18. In an ocean-power, a support, a swinging frame secured to the support; a screw 15 journaled to such frame; means for locking

the frame to hold the screw submerged in the water, and means for conveying power from the screw.

19. In an ocean-power, the combination of two piles; a swinging frame pivoted to both 20 of said piles and having its bottom adapted to engage and be supported by the piles when the frame is in a vertical position; a screw journaled to the lower end of the frame; and means for conveying power from the screw.

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