P. J. KILCULLEN.

WAVE OPERATED DEVICE.

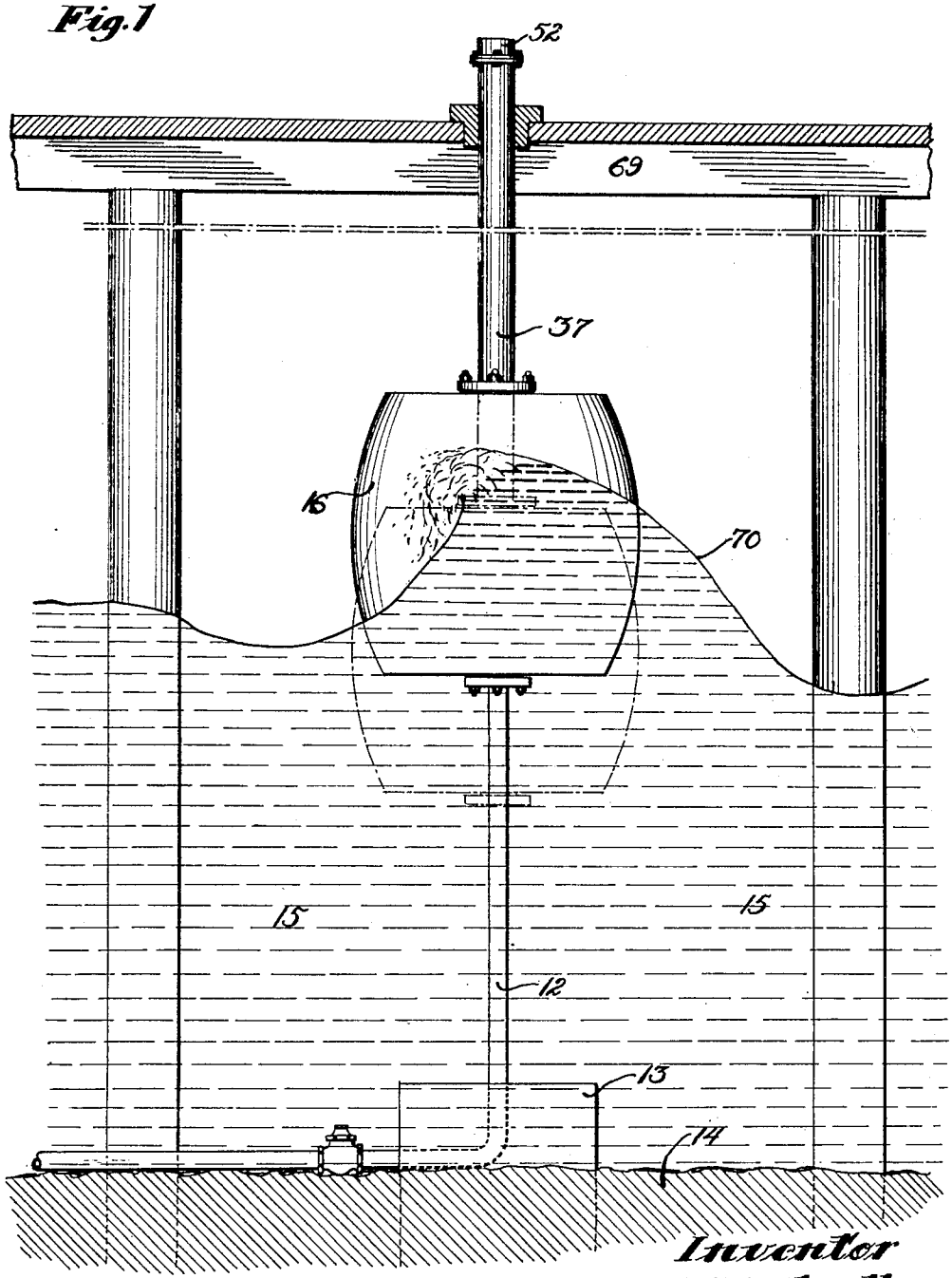
APPLICATION FILED APR. 13, 1920.

1,396,580.

Patented Nov. 8, 1921.

4 SHEETS—SHEET 1.

Fig. 1



Witnesses
Geo. A. Gruss
Augustus B. Copper

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4 SHEETS—SHEET 2.

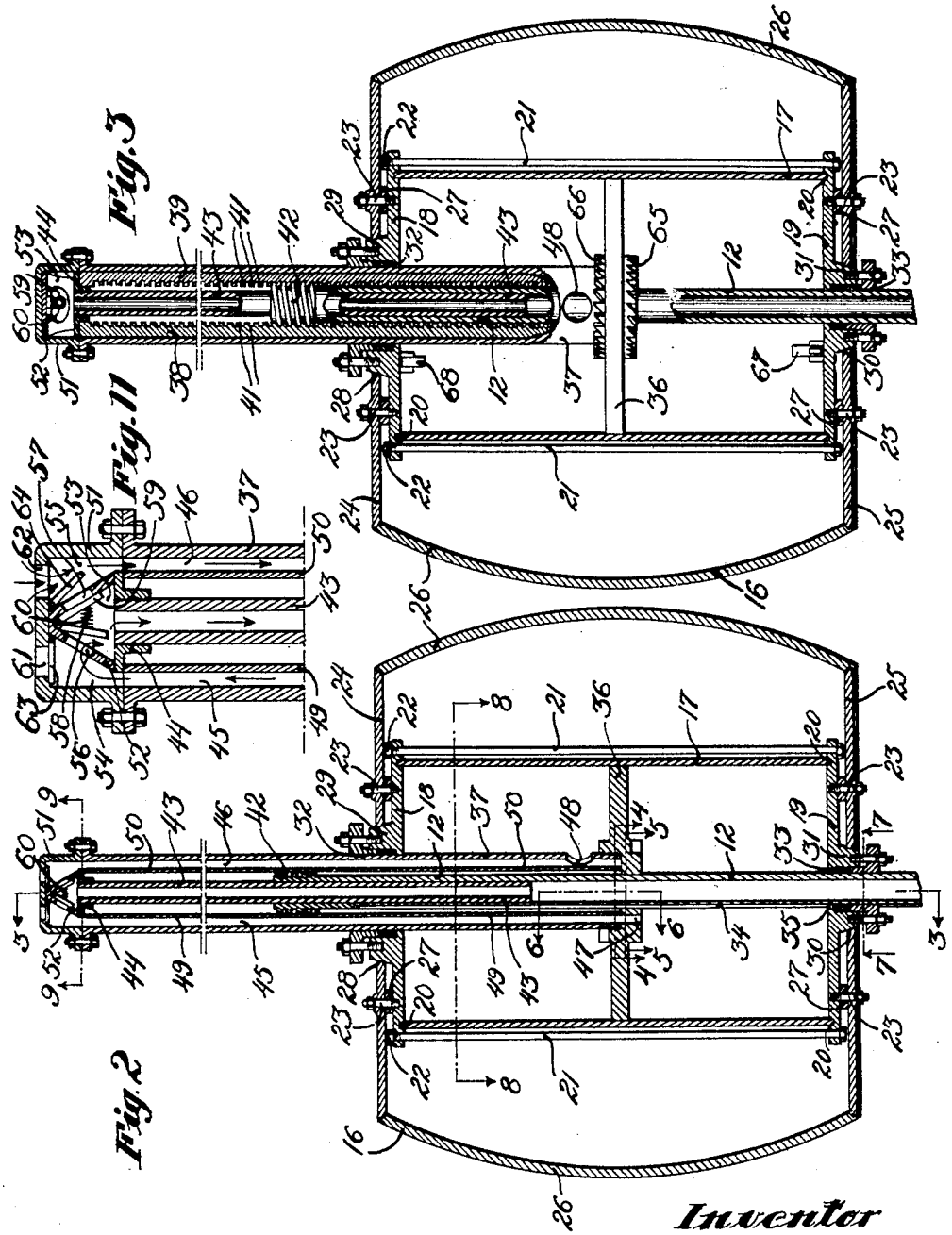


Fig. 3

Fig. 11

Fig. 2

Witnesses

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4 SHEETS—SHEET 3.

Fig. 4

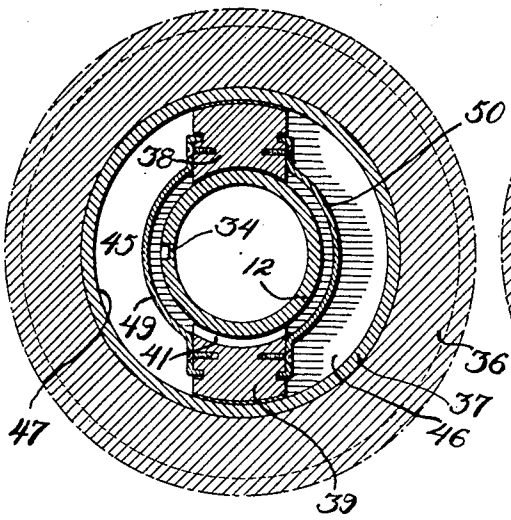


Fig. 5

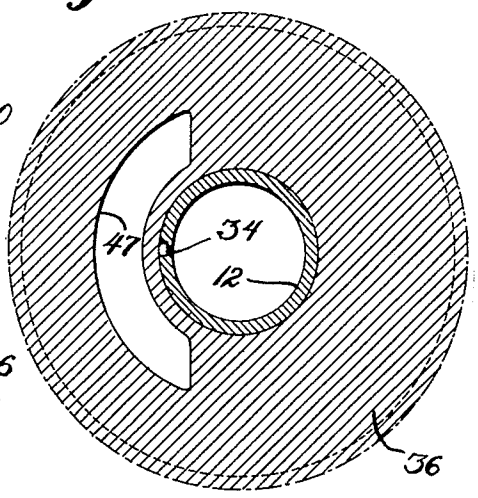


Fig. 6.

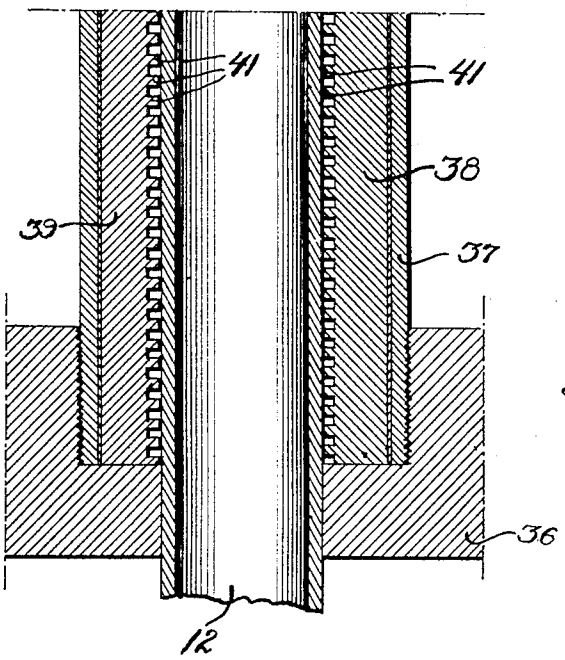
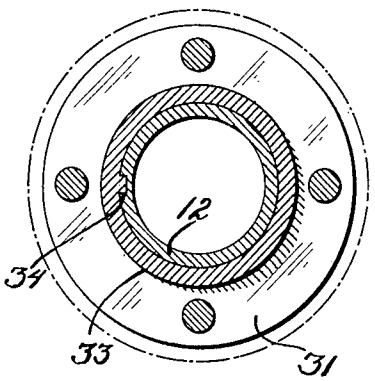


Fig. 7



Witnesses

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4 SHEETS—SHEET 4.

Fig. 8

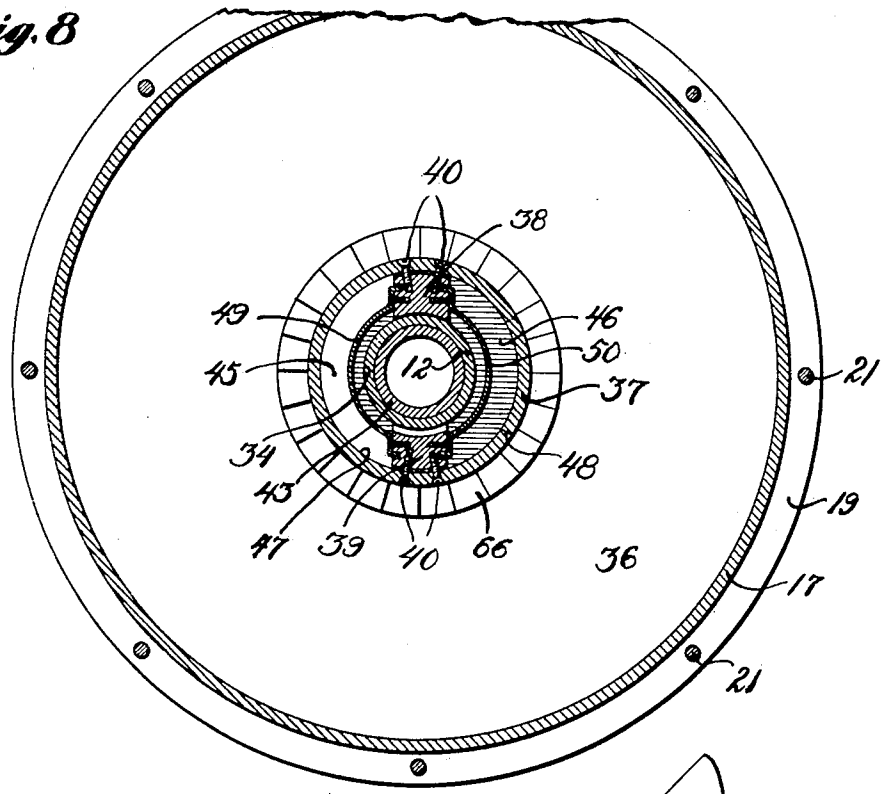


Fig. 9

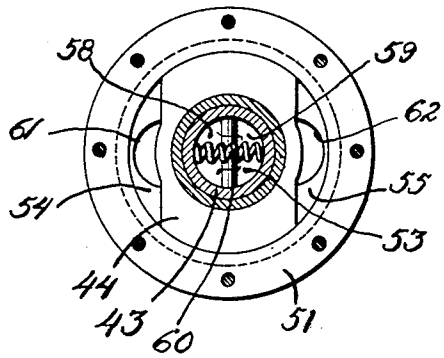
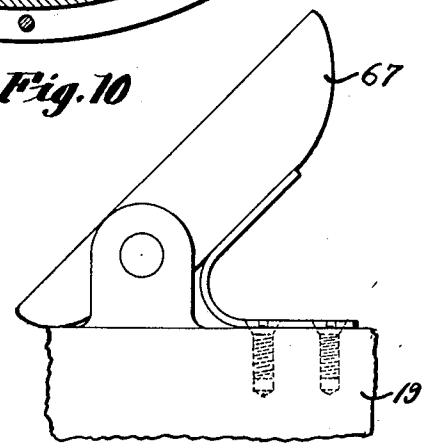


Fig. 10



Witnesses
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UNITED STATES PATENT OFFICE.

PATRICK J. KILCULLEN, OF PHILADELPHIA, PENNSYLVANIA.

WAVE-OPERATED DEVICE.

1,396,580. Specification of Letters Patent. Patented Nov. 8, 1921.

Application filed April 13, 1920. Serial No. 373,471.

To all whom it may concern:

Be it known that I, PATRICK J. KILCULLEN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Wave-Operated Devices, of which the following is a specification.

One object of my invention is to provide means which will operate, due to the action of water waves, for the purpose of pumping and compressing fluid, such as air, so that said fluid can be employed for transmitting power or for any other purpose desired.

Another object is to carry out my invention in a practical device of durable and comparatively simple construction so that the same may be maintained in operative position in tide water and automatically adjust itself to suit various natural conditions and changes caused by the rise and fall of the tide.

These objects, and other advantageous ends which will be described hereinafter, I attain in the following manner, reference being had to the accompanying drawings in which—

Figure 1 is an elevational view showing a device constructed in accordance with my invention,

Fig. 2 is a central sectional elevation of the principal part of my invention,

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 2,

Fig. 4 is an enlarged fragmentary sectional plan view taken on the line 4—4 of Fig. 2,

Fig. 5 is an enlarged fragmentary sectional plan view taken on the line 5—5 of Fig. 2,

Fig. 6 is an enlarged fragmentary sectional elevation taken on the line 6—6 of Fig. 2,

Fig. 7 is an enlarged sectional plan view taken on the line 7—7 of Fig. 2,

Fig. 8 is a sectional plan view taken on the line 8—8 of Fig. 2,

Fig. 9 is a sectional plan view taken on the line 9—9 of Fig. 2,

Fig. 10 is an enlarged fragmentary elevation of certain of the features of my invention, and

Fig. 11 is a fragmentary sectional view drawn on a slightly enlarged scale from that shown in Fig. 2 and illustrating the direction of flow of pumped air and intake air as occurs during the operation of the device in one direction.

Referring to the drawings, 12 represents an upright pipe which may be anchored in a concrete block 13 to the bed 14 of any body of tide water, such as a river, ocean or the like and this pipe may be extended to any suitable storage tanks or to any place desired. The pipe 12 leads upwardly through the body of water 15, as shown in Fig. 1, through a float 16 which in the present instance is illustrated in the form of a barrel. A piston cylinder 17 is located within the barrel 16 and includes upper and lower closure ends 18 and 19; said closure ends including grooves 20 in which the opposite ends of the cylinder fit as clearly shown in Fig. 2. Tie rods 21 extend through the closure ends 18 and 19 outside of the cylinder 17 and are clamped by means of nuts 22. Thus the ends or heads 18 and 19 are securely held to the ends of the cylinder. Stud bolts 23 extend through the head 24 and bottom 25 of the barrel 16 and by tightening up on these bolts 23, the head 24 and bottom 25 will be pulled into tight sealing connection with the side 26 of the barrel; members 27 being interposed between the head 24 and bottom 25 of the barrel and the end closures of the cylinder 17. The members 27 are slightly compressible so as to permit the head 24 and bottom 25 to move relatively toward each other for a purpose of forming a tight closure with the side 26. The head 24 has a hole 28 through which projects an outwardly tapered extension 29 of the end closure 18 of the cylinder 17. The bottom 25 of the barrel also has a hole 30 through which projects an outwardly tapering extension 31 of the end closure 19 of the cylinder 17. Stuffing boxes 32 and 33 are respectively formed on the extensions 29 and 31; the stuffing box 32 being of larger diameter than the stuffing box 33. The pipe 12 slidably fits within the stuffing box 33 and has a spline or key groove 34 into which extends a key projection 35 on the end closure 19 of the cylinder 17. Thus the cylinder 17 and barrel 16 is free to slide upwardly and downwardly on the pipe 12 but rotation between said pipe, barrel and cylinder is prevented.

A piston 36 slidably fits within the cylinder 17 and has a tube 37 in screw threaded connection therewith; said tube slidably

fitting said stuffing box 32 and projecting a considerable distance above the top of the barrel 16. The piston tube 37 has inwardly extending ribs 38 and 39 which, in the present instance, are made of separate pieces secured to the inner surface of the tube 37 by screws 40 as shown in Fig. 8. These ribs 38 and 39 are diametrically opposite each other and the opposed surfaces of the ribs have screw or worm threads 41 thereon adapted to engage a worm or screw threaded portion 42 on the upper portion of said pipe 12; it being noted that said pipe 12 extends freely through the piston 36 and piston tube 37 as clearly shown in Figs. 2, 3, 4, 5 and 8.

A tube 43 has a lower open end portion which telescopically slides within the upper portion of the pipe 12; said telescopic tube 43 at its top being secured in the present instance by a flange head 44 to the top of the piston tube 37. By the above construction and provision of the ribs 38 and 39, it will be noted that two upright chambers 45 and 46 are provided within the piston tube 37 at opposite sides of the ribs 38 and 39 as clearly shown in Figs. 2, 4 and 11; said chamber 46, as shown in Fig. 2, terminating at the top of the piston while the chamber 45 is in alinement with a slot 47 extending entirely through the piston so that said chamber 45 communicates with the space between the piston 36 and the end closure 19 of the cylinder. The piston tube 37 has a hole 48 which communicates with the chamber 46 and with the interior of said cylinder between the piston 36 and the top closure end 18 of the cylinder. Partition plates 49 and 50 extend upwardly, within the piston tube 37, from the piston 36 to the flange head 44 and throughout their length are secured to the ribs 38 and 39 as clearly shown in Fig. 4. These partition plates 49 and 50 form sealing members to prevent leakage of fluid pressure within the chambers 45 and 46 as will be more fully described hereinafter. The chambers 45 and 46 terminate within a valve cap 51 secured to the top of the piston tube 37; said valve cap having an inverted V-shape partition 52 having holes therein which provides a compartment 53 which communicates with the upper end of the telescopic tube 43 as clearly shown in Fig. 11. The partition 52 extends from the flange head 44 to the top of the valve cap 51 and also provides lateral compartments 54 and 55 which respectively communicate with the tops of the upright chambers 45 and 46. Valve openings 56 and 57 extend through the partition 52 and form communication between the central compartment 53 and the lateral compartments 54 and 55. Valves 58 and 59 are pivoted within the central compartment 53 and have a spring 60 interposed between them for the purpose of normally keeping the openings 56 and 57 closed. Valve openings 61 and 62 are formed in the cap 51 and lead from the atmosphere into the respective lateral compartments 54 and 57. Trap valves 63 and 64 are pivotally mounted within the compartments 54 and 55 and serve to keep the valve openings 62 and 63 closed under certain operative conditions hereinafter described.

The bottom of the piston 36 has ratchet teeth 65 thereon arranged in annular formation and the top of the piston 36 has ratchet teeth 66 thereon also arranged in annular formation. The end closure 19 of the cylinder has a pivoted pawl 67 which projects upwardly so that upon the rise of the tide in the manner hereinafter described the pawl 67 engages the ratchet teeth 65 and tends to rotate the piston and piston tube so that, due to the engagement of the threads 41 with the worm 42, the piston 36 will be raised relatively to the bed 14 of the body of water 15 as will be described more fully hereinafter. The end closure 18 of the cylinder also has a pivoted pawl 68 for the purpose of co-acting with the ratchet teeth 66 upon the fall of the tide for the purpose of rotating the piston tube in an opposite direction so as to cause the piston to fall with respect to the bed 14 of the body of water 15. In this manner the barrel 16 can be kept adjacent the wave surface of the body of water at all times irrespective to the change of the tide.

In the accompanying drawings I have illustrated the piston tube 37 slidably mounted in an overhead supporting structure 69 which may be the top of a pier. However, it will be understood that any suitable means can be employed for preventing the action of the water from moving either the pipe 12 or piston tube 37 out of vertical position.

The operation of the device as above described is as follows: Considering that the barrel is in the position shown in dot-and-dash lines in Fig. 1 and is encountered by a wave such as illustrated at 70, the barrel and cylinder will be raised, due to the buoyant action of the water upon the barrel and air which is confined within the space between the piston 36, and the end closure 19 of the cylinder will be compressed and forced upwardly through the slot 47 and chamber 45 into the lateral compartment 54 and in so doing will swing the valve 58 open to permit the air to pass through the valve opening 56 into the compartment 53 and thence downwardly through the tube 43 and pipe 12. The partial vacuum which is created between the piston 36 and upper end closure 18 of the cylinder 17 will cause air to be drawn downwardly through the opening 62, lateral compartment 55, chamber 46 and hole 48. After the wave has passed the barrel

16, the barrel will move downwardly and in so doing the trap valve 63 will open and permit air to enter the cylinder below the piston 36 through the chamber 45 and air within the cylinder above the piston 36 will be forced upwardly through the chamber 46 and valve opening 51 into the tube 43 and pipe 12. In this manner air will be forced through the pipe 12 and any number of these devices can be applied to a single main and the air thus pumped can be used for various purposes, such for example as power transmission or the like. Upon the rise of the tide the barrel will rise gradually to higher levels until upon its upward movement the pawl 67 strikes the ratchet teeth 65 and then upon each successive rising movement, the piston tube will be rotated and thereby raised due to the connection between the threads 41 and worm 42 as above described. On the other hand when the tide falls the pawl 68 will successively act in conjunction with the ratchet teeth 66 to rotate the piston tube in an opposite direction and thereby lower the piston.

It will be noted that the partition plates 49 and 50 prevent leakage of air from one chamber to another which might occur through the worm screw connection if said plates 49 and 50 were not present.

While I have described my invention as taking a particular form, it will be understood that the various parts of my invention may be changed without departing from the spirit thereof, and hence I do not limit myself to the precise construction set forth, but consider that I am at liberty to make such changes and alterations as fairly come within the scope of the appended claims.

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

1. A device of the character described including means adapted to float in a body of tide water; a conduit; means operative due to the wave action of the water on said floating means to pump a fluid through said conduit; and means including a screw thread connection operative upon movement of the floating means beyond predetermined limits to effect a gradual relative change in position between said first and second means to compensate for the rise and fall of the tide; substantially as described.

2. A device of the character described including a hollow float member; a piston therein; means providing a passageway having openings in communication with the interior of said hollow member at opposite sides of the piston; means for supplying air into said member alternately at opposite sides of said piston, said float member being operative, due to wave action, to be raised and lowered whereby said air at opposite sides of the piston will be forced through said passageway; and means automatically operative to raise and lower said piston; substantially as described.

3. A device of the character described including a pipe; a hollow float member slidably keyed to said pipe; a piston within said float member; means for admitting air into said float member at opposite sides of said piston; and means providing alternate communication between the interior of said pipe and the space within said hollow member at opposite sides of the piston whereby raising and lowering movement of said float member by wave action will cause air at opposite sides of the piston to be alternately forced through said pipe; substantially as described.

4. A device of the character described including a pipe; a hollow float member slidably keyed to said pipe; a piston within said float member; means for admitting air into said float member at opposite sides of said piston; means providing alternate communication between the interior of said pipe and the space within said hollow member at opposite sides of the piston whereby raising and lowering movement of said float member by wave action will cause air at opposite sides of the piston to be alternately forced through said pipe; means providing a screw threaded connection between said pipe and piston; and means for alternately effecting relative rotation between said pipe and piston due to a change in height of the wave surface whereby the piston will be raised and lowered; substantially as described.

5. A device of the character described having a hollow float member including a cylinder; a pipe slidably keyed to and extending within the cylinder; a piston fitting said cylinder and having a tube extending through said float and into which said pipe extends; means providing separate chambers extending upwardly through said tube; a second tube operatively connected to said first tube in telescopic connection with said pipe, said chambers having openings respectively communicating with the interior of said cylinder at opposite sides of the piston; means providing openings communicating with said second tube and the respective chambers; valves normally closing said openings; and trap valves for admitting air into said chambers whereby when said float is moved upwardly and downwardly by wave action relatively to said pipe, air will be successively drawn into said cylinder at opposite sides of the piston and forced through said pipe; substantially as described.

6. A device of the character described having a hollow float member including a cylinder; a pipe slidably keyed to and extending within the cylinder; a piston fit-

ting said cylinder and having a tube extending through said float and into which said pipe extends; means providing separate chambers extending upwardly through said tube; a second tube operatively connected to said first tube in telescopic connection with said pipe, said chambers having openings respectively communicating with the interior of said cylinder at opposite sides of the piston; means providing openings communicating with said second tube and the respective chambers; valves normally closing said openings; trap valves for admitting air into said chambers whereby when said float is moved upwardly and downwardly by wave action relatively to said pipe, air will be successively drawn into said cylinder at opposite sides of the piston and forced through said pipe; means providing screw threaded connection between said pipe and first mentioned tube; and means for effecting relative rotation between said pipe and first tube due to variation in the height of the wave surface whereby said piston will be raised to accommodate said variation of the wave surface; substantially as described.

7. A device of the character described having a hollow float member including a cylinder; a pipe slidably keyed to and extending within the cylinder; a piston fitting said cylinder and having a tube extending through said float and into which said pipe extends; means providing separate chambers extending upwardly through said tube; a second tube operatively connected to said first tube in telescopic connection with said pipe, said chambers having openings respectively communicating with the interior of said cylinder at opposite sides of the piston; means providing openings communicating with said second tube and the respective chambers; valves normally closing said openings; trap valves for admitting air into said chambers whereby when said float is moved upwardly and downwardly by wave action relatively to said pipe, air will be successively drawn into said cylinder at opposite sides of the piston and forced through said pipe; means providing screw threaded connection between said pipe and first mentioned tube; ratchet teeth at opposite sides of said piston; and pawls located adjacent the top and bottom of the interior of said cylinder for respective engagement with said ratchet teeth upon a variation of height of the wave surface whereby the first mentioned tube is rotated in opposite directions to effect a raising and lowering movement of the piston due to said screw threaded connection; substantially as described.

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

PATRICK J. KILCULLEN.

Witnesses:
JOSEPH A. KILCULLEN,
CHAS. E. POTTS.