No. 714,166. Patented Nov. 25, 1902.

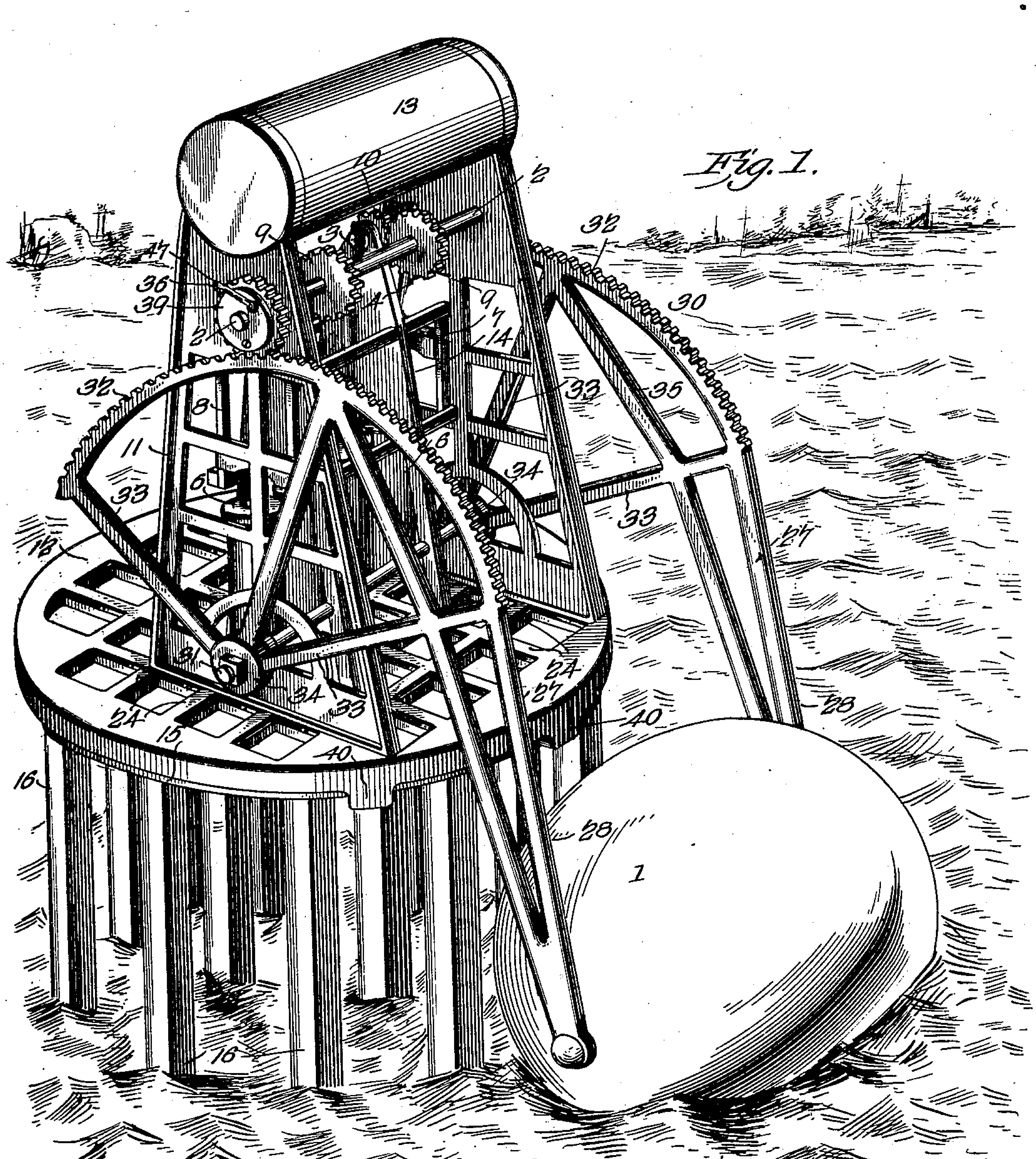
H. C. ESSINGTON.

WAVE AND TIDE MOTOR.

(Application filed Sept. 9, 1901.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



Witnesses
E. F. Stewart
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H. C. Essington Inventor
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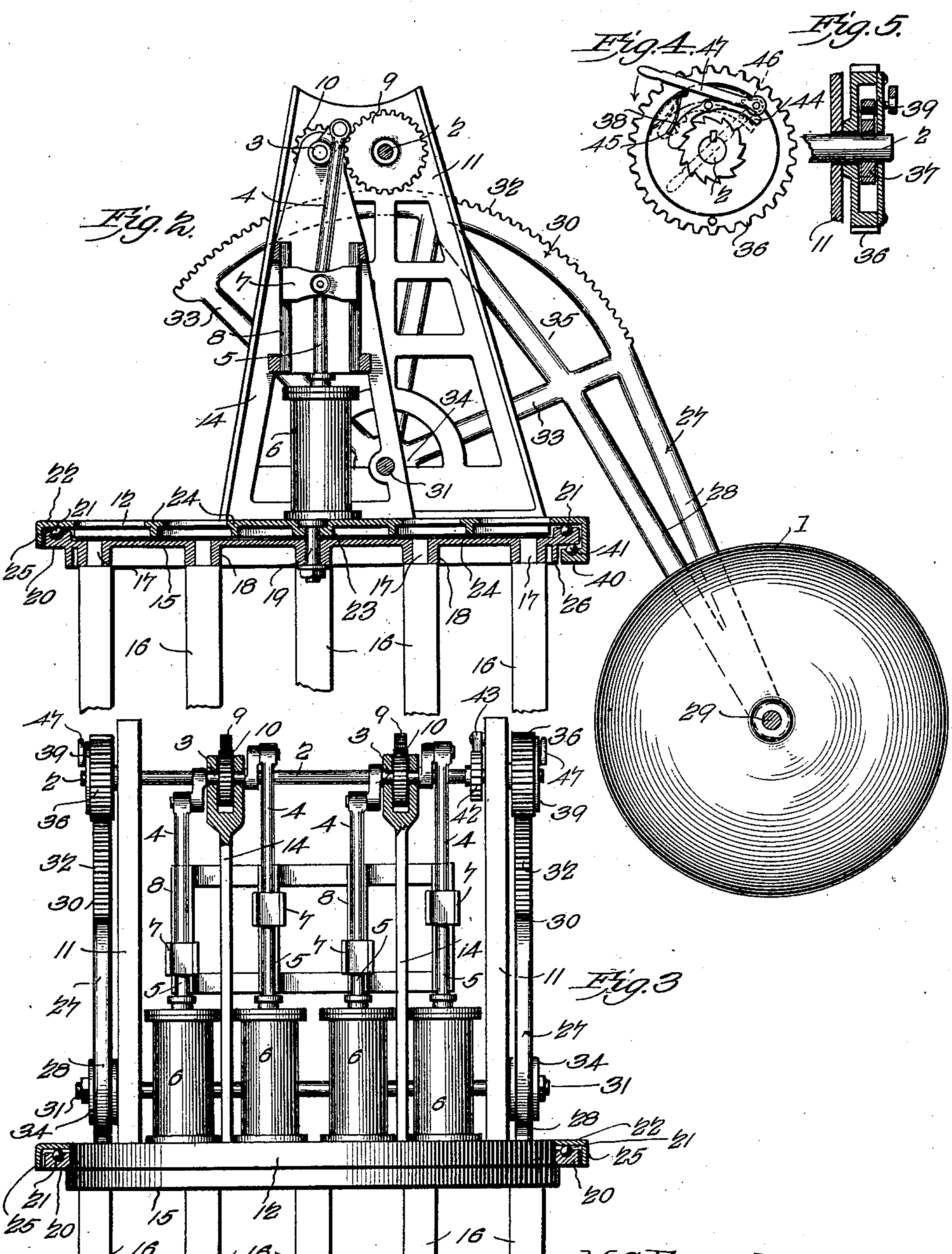

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UNITED STATES PATENT OFFICE.

HENRY CLAY ESSINGTON, OF PHILADELPHIA, PENNSYLVANIA.

WAVE AND TIDE MOTOR.

SPECIFICATION forming part of Letters Patent No. 714,166, dated November 25, 1902.

Application filed September 9, 1901. Serial No. 74,831. (No model.)

To all whom it may concern:

Be it known that I, HENRY CLAY ESSINGTON, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Wave and Tide Motor, of which the following is a specification.

My invention relates to wave and tide motors, and has for its object to provide an apparatus of this class wherein the maximum efficiency of the float or driving element is attained and whereby the driven element, from which motion is communicated to the pumps or other actuated objects, receives an effective motion from a minimum operation of the driving element, as when affected by small waves or a slight swell known as the "ground-swell."

A further object of the present invention is to provide means whereby the advancing or progressive force of the waves is utilized in addition to the rising or buoying effect thereof and whereby the motion received by the driving element is communicated to the driven element with the minimum loss due to friction or transverse strains.

A further object of the invention is to provide efficient means for relieving the driving element of transverse strains due to cross or "chop" seas and to provide means whereby the direction of effective motion of the driving element is varied to suit the direction of approach of the waves.

A further object of the invention is to provide means whereby the driving element is shielded from excessive buffeting without materially impeding the motion of the water prior to reaching the float.

Further objects and advantages of the invention will appear in the following description, and the novel features thereof will be particularly pointed out in the appended claims, it being understood that various changes in the form, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

In the drawings, Figure 1 is a perspective view of a motor constructed in accordance with my invention. Fig. 2 is a partial vertical section of the same. Fig. 3 is a front elevation, partly in section. Fig. 4 is a detail view of the driven gear and clutch mechanism with the cap-plate removed. Fig. 5 is a cross-section of the same.

Similar reference characters indicate corresponding parts in all the figures of the drawings.

The motor embodying my invention comprises, essentially, an operating element which is mounted for vibratory or oscillatory movement and includes a float 1, adapted to ride upon the surface of the water, and a driven element adapted for intermittent rotary movement in a uniform direction and consisting, in the construction illustrated, of a shaft 2, adapted for connection with mechanism to be driven. In the preferred embodiment of my invention this driven element is operatively connected by suitable intermediate gearing (which may be of a speed-multiplying type) with crank-shafts 3, of which the cranks are connected by pitmen 4 with piston-rods 5, forming elements of air-compressing pumps, including the cylinders 6. These pump mechanisms, however, form no part of my invention, and therefore are not shown in detail. The piston-rods are shown provided with cross-heads 7, operating in guides 8 to insure longitudinal movement without vibration or displacement; also, in the construction illustrated the driven element, consisting of the shaft 2, is connected with the crank-shafts by intermeshing gears 9 and 10, of which the former are of larger diameter than the latter to insure rotation of the crank-shafts at a speed greater than the driven shaft.

The above-described mechanism is mounted upon a framework preferably consisting of the open-work side frames 11 and a revoluble turn-table 12, a suitable tank or reservoir 13 being located upon the upper ends of the side frames to receive compressed air from the pumps when the apparatus is used for air-compression, although I have deemed it unnecessary to show specifically the connections between the pumps and this receptacle. The crank-shafts may, as illustrated, be supported by standards 14, rising from the turn-table; but it will be understood that the details of the mounting of the pumps or other operated devices may be varied to suit the purpose for which the apparatus is designed.

The turn-table is mounted upon a fixed base 15, supported by piles 16, the upper ends of the piles in the construction illustrated being reduced, as shown at 17, for reception by sockets 18, depending from the base, a central pivot-bolt or spindle 19 being employed to connect the turn-table with the base. The base is of open-work or perforate construction and at its periphery is provided with a raised bearing-ring 20, having a ball-race in which are arranged antifriction balls or rollers 21 to receive the bearing-ring 22 of the turn-table, and the latter between said bearing-ring 22, and its central hub 23 (through which the pivot-bolt or spindle extends) is of open-work and is provided with strengthening-ribs 24. It will be understood that the open-work construction is designed to insure the necessary strength with the minimum weight of the parts. Also the turn-table is provided with an annular depending flange or guard 25 of an interior diameter slightly in excess of the diameter of the bearing-ring 20 to prevent lateral displacement of the table and relieve the pivot bolt or spindle from excessive strain. It may be possible under certain circumstances to omit the pivot bolt or spindle and depend upon said flange to maintain the parts in operative relations. Also the base or platform 15 is provided with an annular depending strengthening-flange 26.

The driving element, in addition to the float 1, includes a swinging frame 27, preferably consisting of suitably-braced arms 28, of which the outer terminals are arranged at opposite extremities of the axis of the float 1 and are connected thereto by trunnions 29, whereby the float is free to rotate on its axis and yield to a greater or less extent to strains applied on lines parallel with tangents. At their inner ends said arms are connected with driving-segments 30, mounted centrally upon the supporting-frame and preferably connected for simultaneous movement by a transverse shaft 31. In the construction illustrated each segment consists of a toothed rim 32, prolonged at one end to form the upper member of an arm 28, radial spokes or braces 33 being employed to connect said rim at intervals with the hub 34, and connecting the forward spoke or brace 33 with an intermediate spoke or brace, preferably arranged near the center of the segment, is a tension-brace 35, extended beyond the forward spoke or brace 33 to form the lower or inner member of the arm 28, said lower or inner member and the upper or outer member being converged from their point of intersection with the forward spoke 33 toward the outer extremity of the arm, where they are connected. In practice each arm, with its connected segment, with the spokes or braces, may be cast either in a single structure or in sections for subsequent connection.

The segment or driving-gear is preferably arranged adjacent to but outside of the corresponding side frame and meshes with a driven gear 36, loosely mounted upon the driven shaft 2, forward motion being communicated from the gear to the shaft by means of a suitable clutch mechanism, which in practice may be of any preferred construction. I have found that an effective clutch consists of a ratchet-wheel 37, keyed to the shaft 2, and a pawl 38, pivotally mounted upon the gear for engagement with the ratchet-wheel, such a clutch being illustrated in the drawings Figs. 4 and 5. The driven gear may be of hollow construction to form a casing for the reception of the ratchet-wheel and pawl and may be closed at its outer side by a suitable cap-plate 39, whereby access may be had thereto for cleaning and repairing.

It will be observed from the foregoing description, when taken in connection with the drawings, that my preferred construction of oscillating member consists of a segmental gear having an arm extended tangentially therefrom, and I have found in practice that by employing an arm consisting of outwardly-convergent members I am enabled to mount the segment approximately on the diameter of the turn-table, preferably a short distance in advance thereof or toward that side of the turn-table adjacent to which the float is located. This enables me to secure the full drop of the float at the side of the platform or the base-frame by which the turn-table is supported, and thus provide for a wide range of variation between low and high tide, the oscillating frame in its fully-depressed position being so located that the arms 28 occupy an approximately vertical position with the float adjacent to the piles at that side of the structure. Thus when the tide is low the motion of the float in operation is toward and from the supporting-frame, the lateral spacing of the arms being such as to permit the float to approach almost or quite to the plane of the supporting-piles on that side of the structure. Any suitable means may be employed for preventing pounding, although in practice it is usually unnecessary to provide such means if the elevation of the turn-table is such that when the surface of the water is at its lowest point the float will be out of actual contact with the piles. I have also found in practice that the described construction of the oscillating frame provides for the maximum effective stroke or amplitude of vibration of the float, and the above-described outward-swinging movement of the float from its point of lowest depression enables me to utilize not only the rise and fall of the surface of the water due to the waves, but also the forward impulse thereof in approaching the float.

One of the most destructive elements in connection with devices of this class is the side strain due to the contact of cross-seas or "chop" waves, which approach the float in a direction other than perpendicular to the axis thereof; but by mounting the mechanism, including the float-supporting arms, upon a re-

voluble table I adapt the same to adjust itself to the direction of approach and to yield when the float receives the impact of a cross-wave and at the same time obtain the full benefit of the impulse of the wave. Moreover, I increase the buoyant effect of the float by elongating it axially, so that the surface which is in contact with the water is extended.

The provision of means whereby the oscillatory frame is adapted to yield to suit the direction of approach of the waves also has the effect of disposing the float on the lee side of said structure, and thus to some extent shielding the float from the excessive impact of the waves, especially when a heavy sea is running, while the spacing of the piles allows the float to receive the full effect of the rise and fall of the surface of the water.

An important advantage of the structure herein described resides in the fact that the driven gear is of very small diameter as compared with that of the driving-segment, and hence a limited vibration of the float due to a wave of minimum magnitude will cause at least one complete revolution of the driven shaft, and hence one complete stroke of the pumps or other devices which receive their motion from the driven shaft. This is a matter of importance in connection with a motor of this class, for the reason that it provides for leaving the pumps under ordinary conditions after each operative stroke of the oscillatory frame in a terminal position rather than in an intermediate position; but in order to avoid backward strain due to the expansive force of the contents of the pump-cylinders the crank-arms may be disposed on the quarter, so as to counterbalance each other.

Inasmuch as the above-described mechanism provides for utilizing the upward impulse or tendency of the waves in communicating motion to the driven element, I employ at the forward side of the turn-table one or more guard-lips 40, formed as extensions or attached to the lower edges of the guard-flanges 25 to extend inward under the bearing-rim 20 and provided with ball-races in which are arranged antifriction balls or rollers 41, which bear against the inner side of said bearing-rim and are adapted to traverse the entire under surface thereof in the course of the adjustment of the turn-table to suit the direction of approach of the waves.

An important advantage of the open-work platform hereinbefore described resides in the fact that in a heavy sea the upward impulse of the water, either at the crest of the waves or owing to the dashing of the same against the piles, will not have the effect of raising the platform or straining the connections between the same and the piles upon which it rests. It will be understood, moreover, that while I have described the apparatus as adapted for use in compressing air it may be used for pumping water or other liquid, either for irrigating, storage, or other purposes, or as a means for communicating power for driving machinery. The arrangement of the piston-operating cranks so that the piston of one pump is on its active stroke during the movement of the piston of another pump on its inactive or backward stroke has the effect of conserving power or economizing power, so as to produce the greatest efficiency in operation, and a further effect of this arrangement is to take up or neutralize backward strain on the operating means, and particularly the shaft. To prevent backward rotation of the crank-shaft, a ratchet 42 is fixed thereon and is engaged by a pawl 43, mounted upon a suitable member of the framework. By the use of this device only the forward or effective strokes are communicated to the shaft, and expansive force of the air or other fluid which is being pumped is prevented from causing backward rotation of the shaft.

In order to provide for stopping the engine when its operation is not desired, I provide the pawl 38 of the operating-clutch with a tail or extension 44, a spring 45 being arranged to hold the forward end or nose of the pawl in its operative position, and in operative relation with said tail or extenston is a cam 46 of a stopping-lever 47. This lever is fulcrumed in such a position with relation to the clutch members that when it is depressed to the position indicated in dotted lines in Fig. 4 the cam, acting upon the tail or extension of the pawl, raises the nose or operative end thereof out of engagement with the ratchet, whereas when the free end of the lever is elevated the pawl is released and allowed to return to its normal position. The lever may be held in this position by the contact of the tail or extension of the cam, or any suitable means may be provided for maintaining the lever in its adjusted position. As such means forms no part of my present invention, I have deemed it unnecessary to illustrate the same.

Having described my invention, what I claim is—

1. A wave-motor having driving and driven elements of which the former includes a float, and a pivoted gear-segment having a tangentially-disposed arm connected to said float.

2. A wave-motor having driving and driven elements, of which the former includes a float, a gear mounted for oscillatory movement, and an arm connecting the float with the gear and disposed tangentially to the latter.

3. A wave-motor having driving and driven elements, of which the former includes a float, and an oscillatory frame having a gear-segment and a rigid arm extended tangentially from the segment and connected to said float.

4. A wave-motor having driving and driven elements, of which the former includes a float and an oscillatory frame having a segment consisting of a rim, a hub and radial spokes or braces, an arm extended tangentially from one extremity of the rim, and a tension-brace

diverging rearwardly from the float-supporting end of the arm and intersecting the segment between its rim and its hub.

5. A wave-motor having driving and driven elements, of which the former includes a float, a pivoted gear-segment having a tangentially-disposed arm connected to said float, and of which the latter comprises a driven shaft, a gear meshing with said gear-segment and of a diameter less than the same, and a clutch for communicating motion from the gear to the shaft when the gear is moved in one direction.

6. A wave-motor having driving and driven elements including a float and means for communicating motion therefrom, a turn-table supporting said driving and driven elements, said float having a pivotal connection with the turn-table on the same side of the center of rotation of said turn-table as that on which said float is located.

7. A wave-motor comprising in combination, a turn-table, means for supporting the same, a float, and a pivoted frame carried by the turn-table and connected to said float, the pivotal axis of the frame and the float being both on the same side of the center of rotation of the turn-table.

8. A wave-motor having driving and driven elements, of which the former includes a float and an oscillatory float-supporting frame, and a turn-table supporting said driving and driven elements and having its axis parallel with the plane of oscillation of said frame, the axis of movement of said frame being in advance of the axis of the turn-table.

9. A wave-motor having driving and driven elements, of which the former includes a float mounted for oscillatory movement, a turn-table upon which said driving and driven elements are mounted, and a platform or support for said turn-table, the turn-table being provided with a guard-lip underlapping the platform or support to prevent upward displacement of the turn-table.

10. A wave-motor having driving and driven elements, of which the former includes a float mounted for oscillatory movement, a turn-table upon which said driving and driven elements are mounted, and a platform or support for said turn-table provided with a bearing-rim, the turn-table having a guard-lip underlapping said bearing-rim.

11. A wave-motor having driving and driven elements, of which the former includes a float mounted for oscillatory movement, a turn-table upon which said driving and driven elements are mounted, a platform or support upon which the turn-table is mounted, said platform or support having a bearing-rim provided with antifriction bearing devices, and the turn-table being provided with a guard-flange encircling the bearing-rim.

12. A wave-motor, having driving and driven elements of which the former includes a float, and a clutch mechanism for communicating motion from the former to the latter, said clutch mechanism including a ratchet, a pawl yieldingly held in engagement with the ratchet, an operating-lever mounted on the pawl-carrying member, and a cam connected to said lever and adapted to move said pawl to effect its disengagement from the ratchet.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

HENRY CLAY ESSINGTON.

Witnesses:

CHAS. F. KAST,

J. MILES KEPHEART.