W. G. J. BENTLEY & E. C. C. KROUGH.

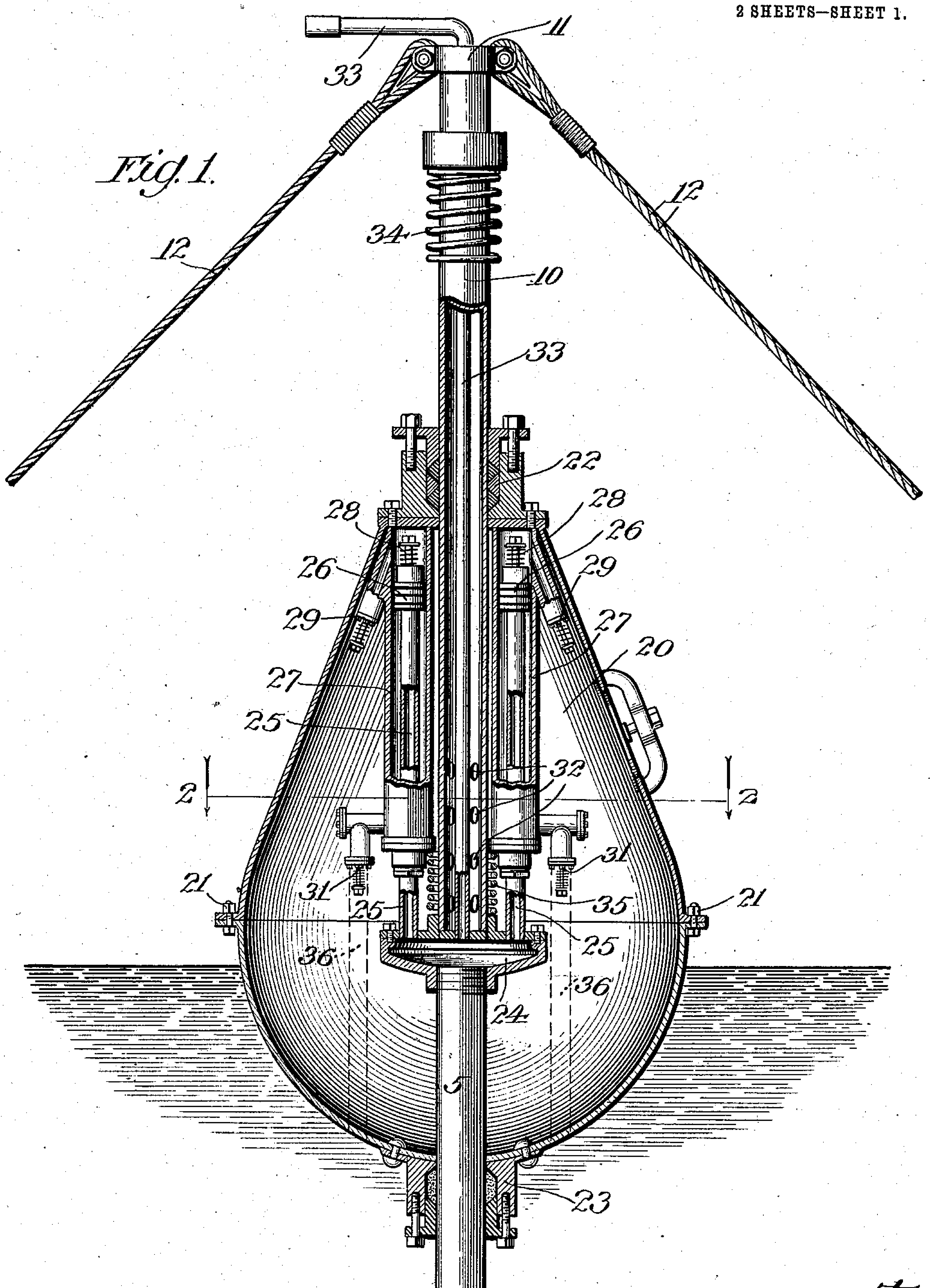
WAVE MOTOR.

APPLICATION FILED JULY 22, 1907.

899,652. Patented Sept. 29, 1908.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
[illegible signature]
Lute S. Alter.

Inventors:
William George J. Bentley,
and Emil C. C. Krough.
By Hazard & Strause
Attorneys.

W. G. J. BENTLEY & E. C. C. KROUGH.

WAVE MOTOR.

APPLICATION FILED JULY 22, 1907.

899,652.

Patented Sept. 29, 1908.

2 SHEETS—SHEET 2.

Fig. 3.

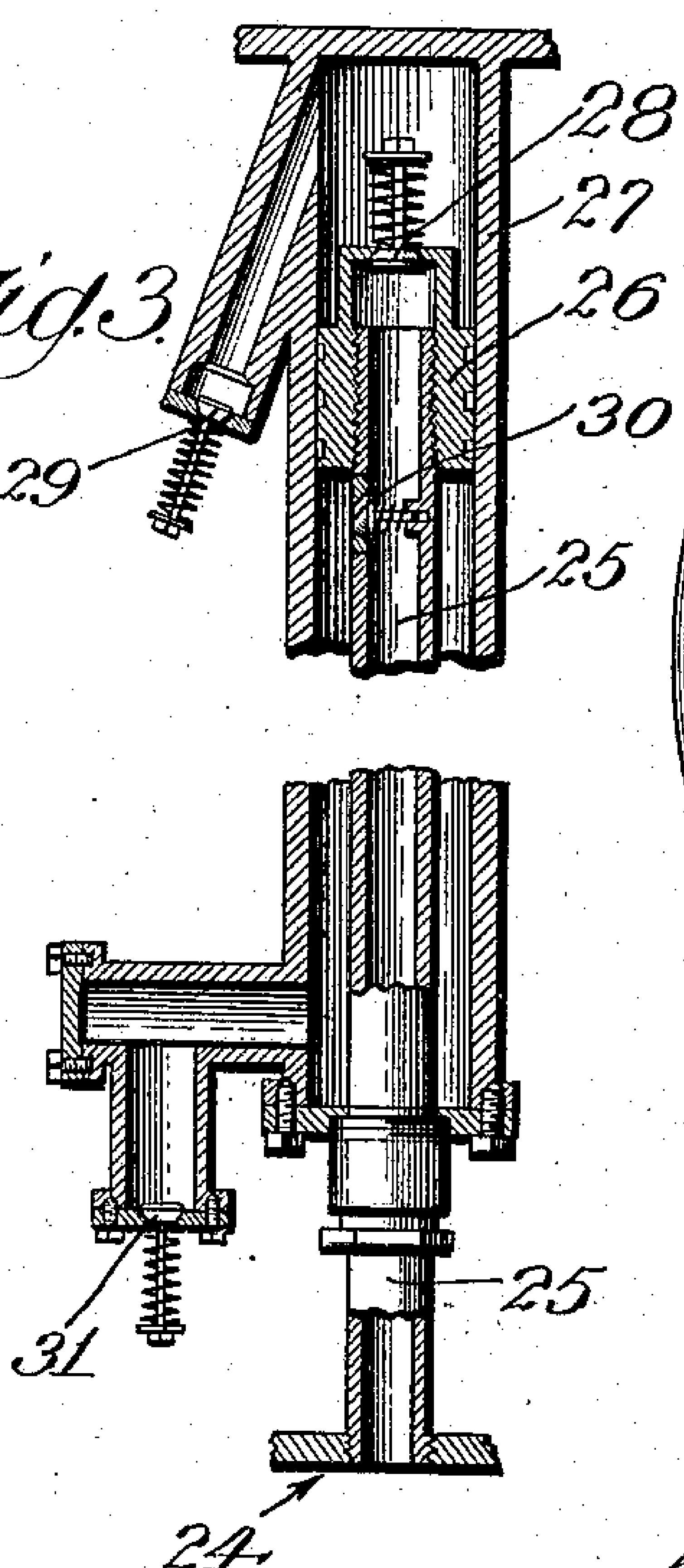


Fig. 2.

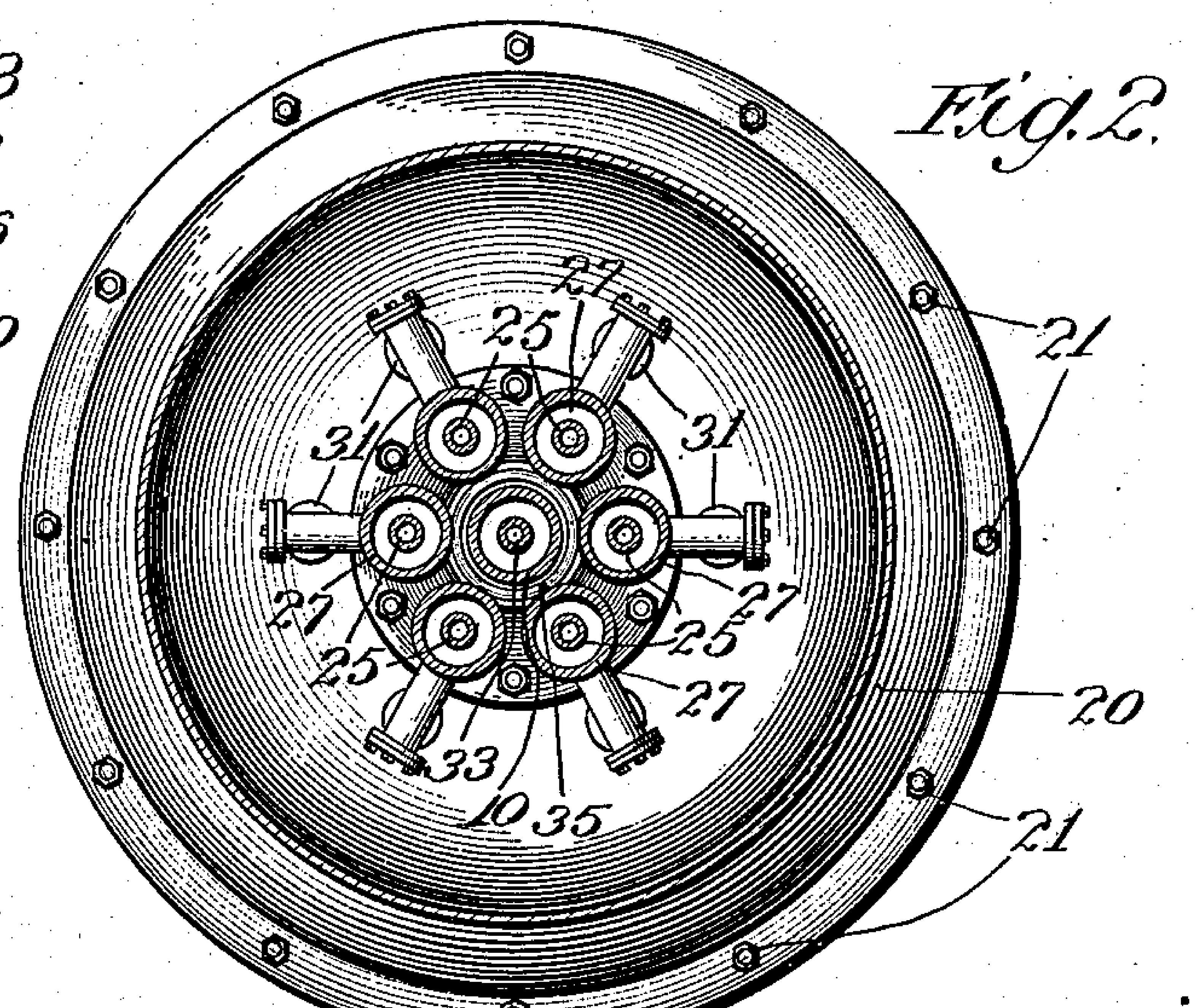
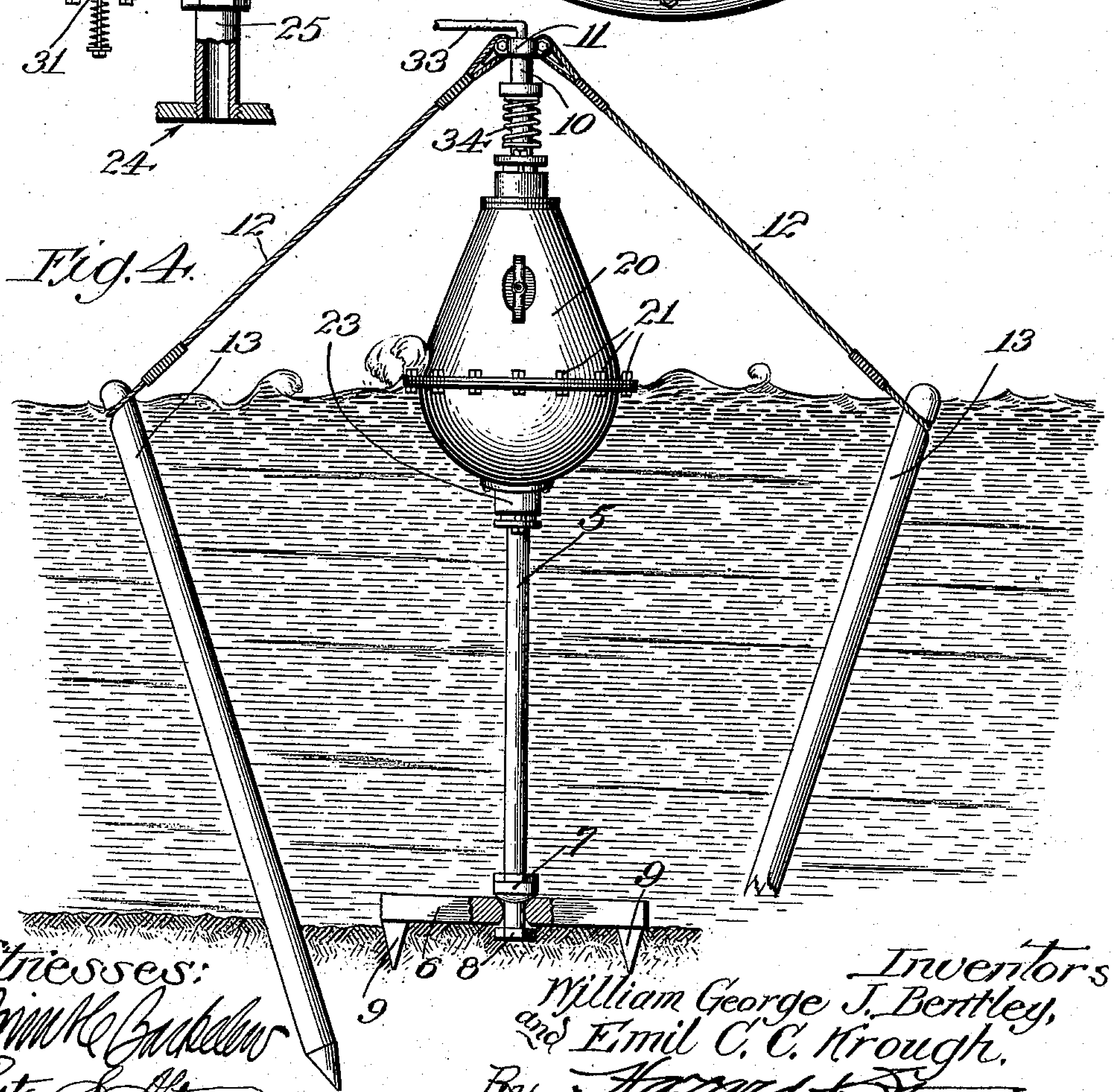


Fig. 4.



Witnesses:
Frank H. Barbelow
Lute S. Alter

Inventors
William George J. Bentley,
and Emil C. C. Krough.
By Hazard & Strause.
Attorneys.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM GEORGE J. BENTLEY AND EMIL C. C. KROUGH, OF LOS ANGELES, CALIFORNIA; SAID KROUGH ASSIGNOR TO SAID BENTLEY.

WAVE-MOTOR.

No. 899,652. Specification of Letters Patent. Patented Sept. 29, 1908.

Application filed July 22, 1907. Serial No. 385,010.

To all whom it may concern:

Be it known that we, WILLIAM GEORGE J. BENTLEY and EMIL C. C. KROUGH, citizens of Canada and the United States, respectively, residing at Los Angeles, county of Los Angeles, and State of California, have invented new and useful Improvements in Wave-Motors, of which the following is a specification.

The object of our invention is to provide a non-destructible wave motor which may be conveniently placed at any distance from the shore and which will utilize with a maximum efficiency the power of sea waves on which it rides.

A further object is to provide a motor which is complete in itself not requiring a pier or other structure for its support.

A further object is to provide a simple mechanism which is entirely protected from the action of the sea waves by the casing of the motor and which may be utilized to pump fluid to a reservoir on the shore or at any other convenient location.

We accomplish these objects by means of the device described herein and illustrated in the accompanying drawing, in which:—

Figure 1. is a vertical longitudinal section of our improved wave motor as it floats in the water. Fig. 2. is a horizontal cross section taken on line 2—2 of Fig. 1. Fig. 3. is an enlarged sectional detail of one of the pumps. Fig. 4. is an elevation showing our wave motor in operation and illustrating the anchorage means for the same.

Referring to the drawings 5 designates a column provided with an anchor plate 6 on its lower end. Column 5 is attached to the anchor plate by means of nuts 7 and 8, the upper one of which is spherical as shown in Fig. 4, so that the upper end of the column may move under stress without disturbing the position of the anchor plate. The anchor plate is provided with lugs 9 on its lower surface which are adapted to enter into the bed of the ocean and prevent the anchor plate from moving. The upper portion 10 of column 5 is hollow as shown in Fig. 1, and its upper end is provided with a collar 11 to which cables 12 are attached and secured to piles 13 driven around column 5. In Fig. 4 only two such piles are shown but any number may be utilized as the conditions necessitate.

Slidably mounted on column 5 is a casing 20, preferably buoy shaped and constructed of boiler plate in two halves secured together by means of flange bolts 21. The upper and lower ends of casing 20 are provided with stuffing boxes 22 and 23, box 22 being provided with metallic packing and box 23 being provided with hemp packing which provides a water tight joint. Inside of casing 20 column 5 is provided with an enlarged air chamber 24 which is secured to the upper solid end of column 5 by being screwed thereon and into which the upper hollow portion 10 of column 5 fits and is carried thereby. Rigidly secured to air chamber 24 are a plurality of hollow piston rods 25 provided on their upper ends with pistons 26 adapted to work in cylinders 27 secured to or formed integrally with the upper half of casing 20. It will be manifest that upon any vertical movement of casing 20 on column 5 cylinders 27 will be moved vertically while pistons 26 will remain stationary. This movement may be utilized to pump any fluid to a reservoir where it may be stored for power purposes but we prefer to pump air and have illustrated our device for that purpose although with slight changes it may be utilized to pump water as will be hereinafter described.

As the several cylinders and mechanisms attached thereto are all exactly alike we will explain but one. Piston rod 25, as before stated, is hollow and communicates with air chamber 24. The upper end of piston rod 25 screws into piston 26 which is provided on its upper face with an inwardly opening puppet valve 28 adapted to connect cylinder 27 above the piston to hollow piston rod 25 upon the downward movement of the cylinder, when valve 28 is opened by the air pressure against it. The upper end of cylinder 27 is provided with an inwardly opening inlet valve 29 similar in construction to valve 28 and which opens on the upward movement of cylinder 27, permitting air to enter the upper end of cylinder 27 to be compressed upon the subsequent downward movement of cylinder 27. Piston rod 25 is provided with a puppet valve 30 opening inwardly from cylinder 27 below piston 26 to the inside of the piston rod. The lower end of cylinder 27 is provided with an inlet valve 31 similar to inlet valve 29 and which is adapted to admit air to the lower end of the cylinder upon the downward movement of the cylinder. Upon the upward movement of the

cylinder valve 30 opens and the compressed air is forced into air chamber 24 through hollow piston rod 25.

By the above described arrangement of valves it is manifest that air will be compressed into air chamber 24 upon the movement of casing 20 in either direction. To admit air to casing 20 we have provided holes 32 in column 10 so that air may pass down column 10 from the open top thereof into the casing. A pipe 33 is secured to and communicates with air chamber 24 and passes out of the upper end of column 10 where it may be connected to a pipe line leading to an air reservoir (not shown). A coiled spring 34 is provided on column 10 near its top for the purpose of arresting any excessive movement of casing 20 without unduly straining the mechanism. A second coiled spring 35 similar to the first, is provided at the lower end of column 10 resting upon air chamber 24 and adapted to contact with the lower end of cylinders 27 as shown in Fig. 1.

It will be observed that by closing holes 32 and providing valves 29 and 31 with connections to the bottom of casing 20 below the water line, it is possible to pump water into a reservoir instead of air. These pipes are shown for valves 31 in dotted line as at 36 and may be easily put in place without disturbing the remainder of the mechanism. It will also be observed that we have provided a wave motor which on account of its simplicity and general conformation will withstand the heaviest seas. This is particularly so on account of the absence of a pier or other heavy structure against which the waves might dash and on account of the substitution therefor of a single column braced by piles driven around the same. It is not necessary to utilize piles as the guy cables may be run off to a sufficient distance to anchor their outer ends directly on the sea bottom. It will further be observed that the mechanism of our motor is completely incased in the inclosing shell so that the sea plays against nothing which is apt to get out of order.

Having described our invention what we claim as new and desire to secure by Letters Patent is:—

1. In a wave motor a vertically disposed column, anchored at its lower end to the sea bottom and guyed at its upper end, a hollow float slidably mounted on said column, and pump mechanism mounted inside of said float and secured to said float and to said column and adapted to be operated by the movements of said float on said column.

2. In a wave motor a vertically disposed column suitably anchored and guyed to the sea bottom, a hollow buoyant float slidably mounted on said column and having water tight bearing surfaces thereon, a plurality of pump cylinders secured to said float on the inside thereof, a plurality of pump pistons secured to said column, means to admit fluid to said cylinders, and means to exhaust the fluid from said cylinders.

3. In a wave motor an anchor plate provided with anchoring lugs on its under surface, a vertically guyed column mounted on said anchor plate, said column being hollow at its upper end, a hollow float slidably mounted on said column, resilient means to limit the vertical movement of said float on said column, a plurality of pump cylinders and valves therefor mounted on the inside of said float, a plurality of pistons mounted on said column and adapted to work in said cylinders, and an exhaust pipe for said cylinders leading up through the hollow portion of said column.

4. In a wave motor an anchor plate, a vertical column pivotally secured to said anchor plate, and a float slidably mounted on said column.

5. In a wave motor an anchor plate, a vertical column pivotally secured to said anchor plate, flexible guys for the upper end of said column, and a float slidably mounted on said column.

6. In a wave motor an anchor plate, a vertical column swingingly secured to said anchor plate, flexible guys for the upper end of said column, a hollow float slidably mounted on said column, and a pump mechanism mounted inside of said float and secured to said float and said column and adapted to be operated by the movements of said float on said column.

7. In a wave motor an anchor plate, a vertical column swingingly secured to said anchor plate, flexible guys for the upper end of said column, a hollow buoyant float slidably mounted on said column and having water tight bearing surfaces thereon, a plurality of pump cylinders secured to said float on the inside thereof, a plurality of pump pistons secured to said column, means to admit fluid to said cylinders, and means to exhaust the fluid from said cylinders.

In witness that we claim the foregoing we have hereunto subscribed our names this 13 day of July, 1907.

WILLIAM GEORGE J. BENTLEY.
EMIL C. C. KROUGH.

Witnesses:
EDMUND A. STRAUSE,
OLLIE PALMER.