

No. 721,090.

PATENTED FEB. 17, 1903.

F. H. REED.
WAVE MOTOR.

APPLICATION FILED MAR. 19, 1902.

NO MODEL.

4 SHEETS—SHEET 1.

FIG. 1

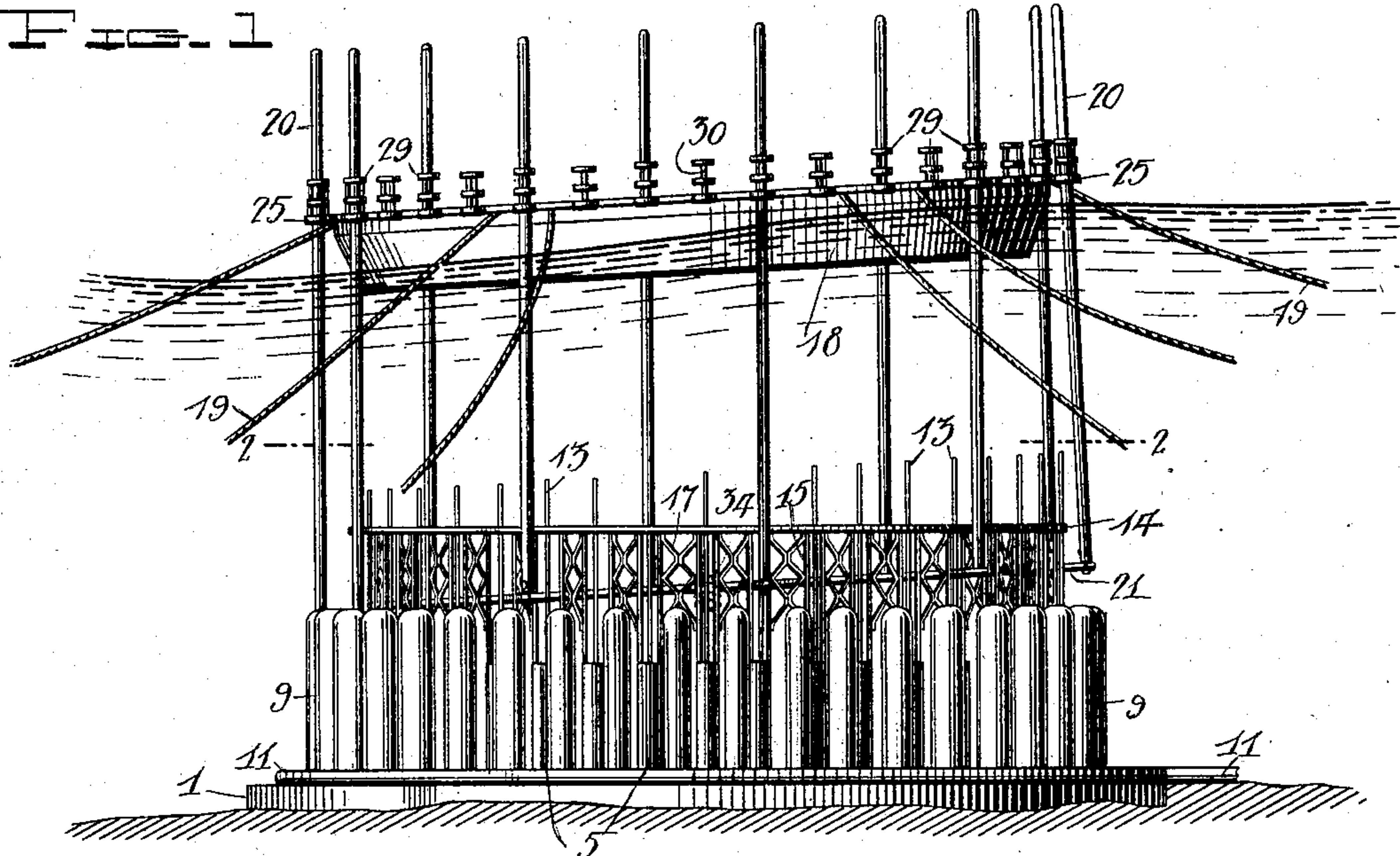
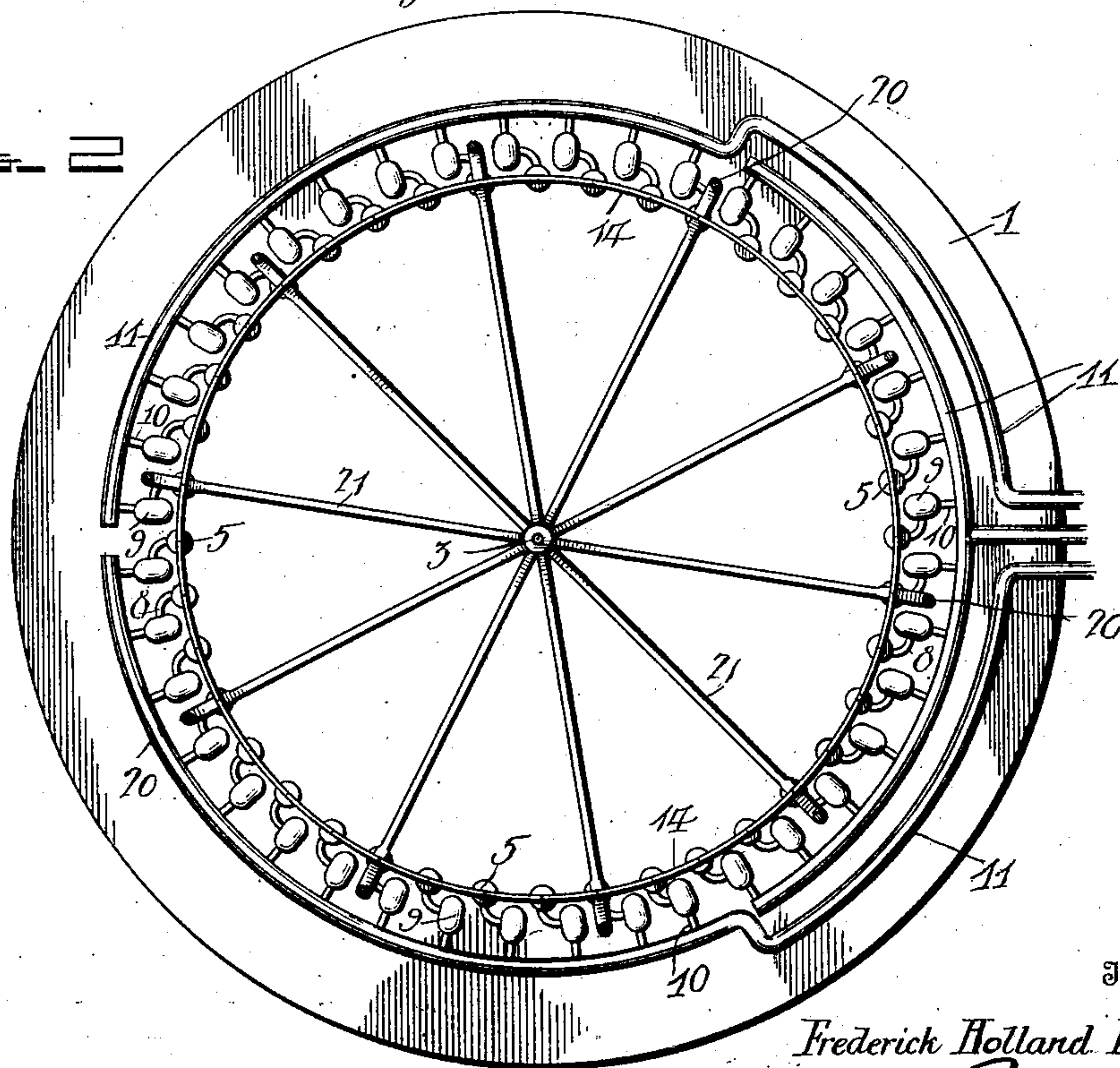


FIG. 2



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4 SHEETS—SHEET 2.

FIG. 4

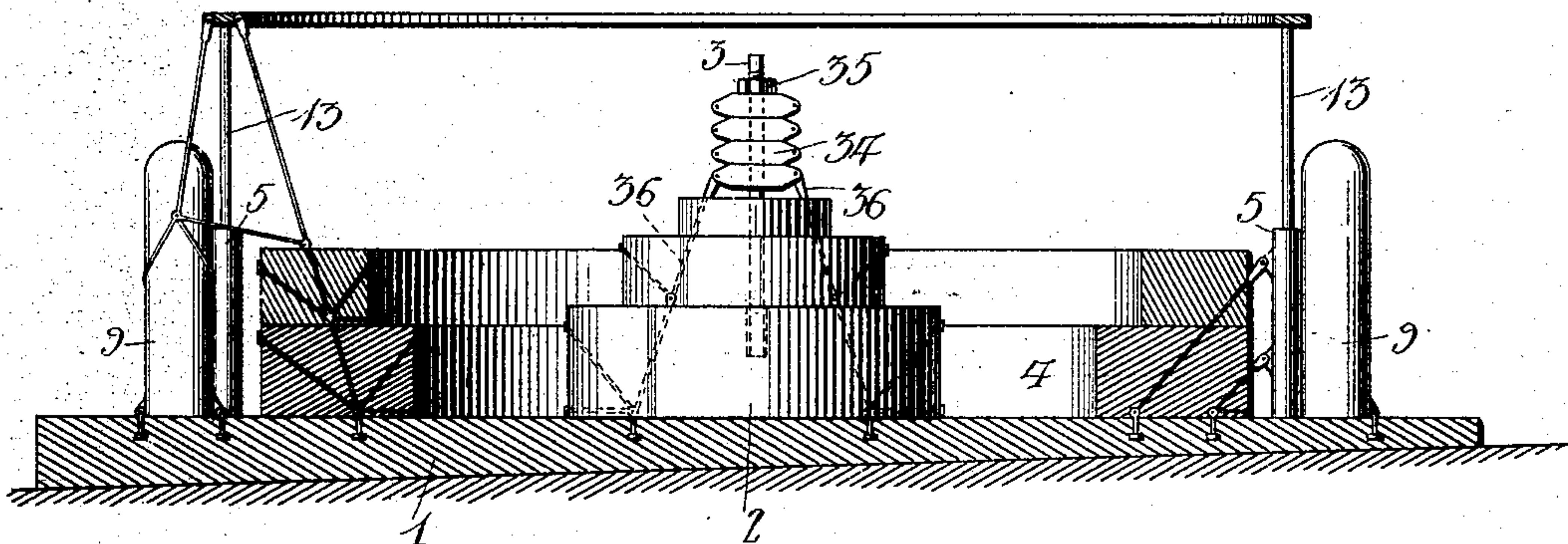
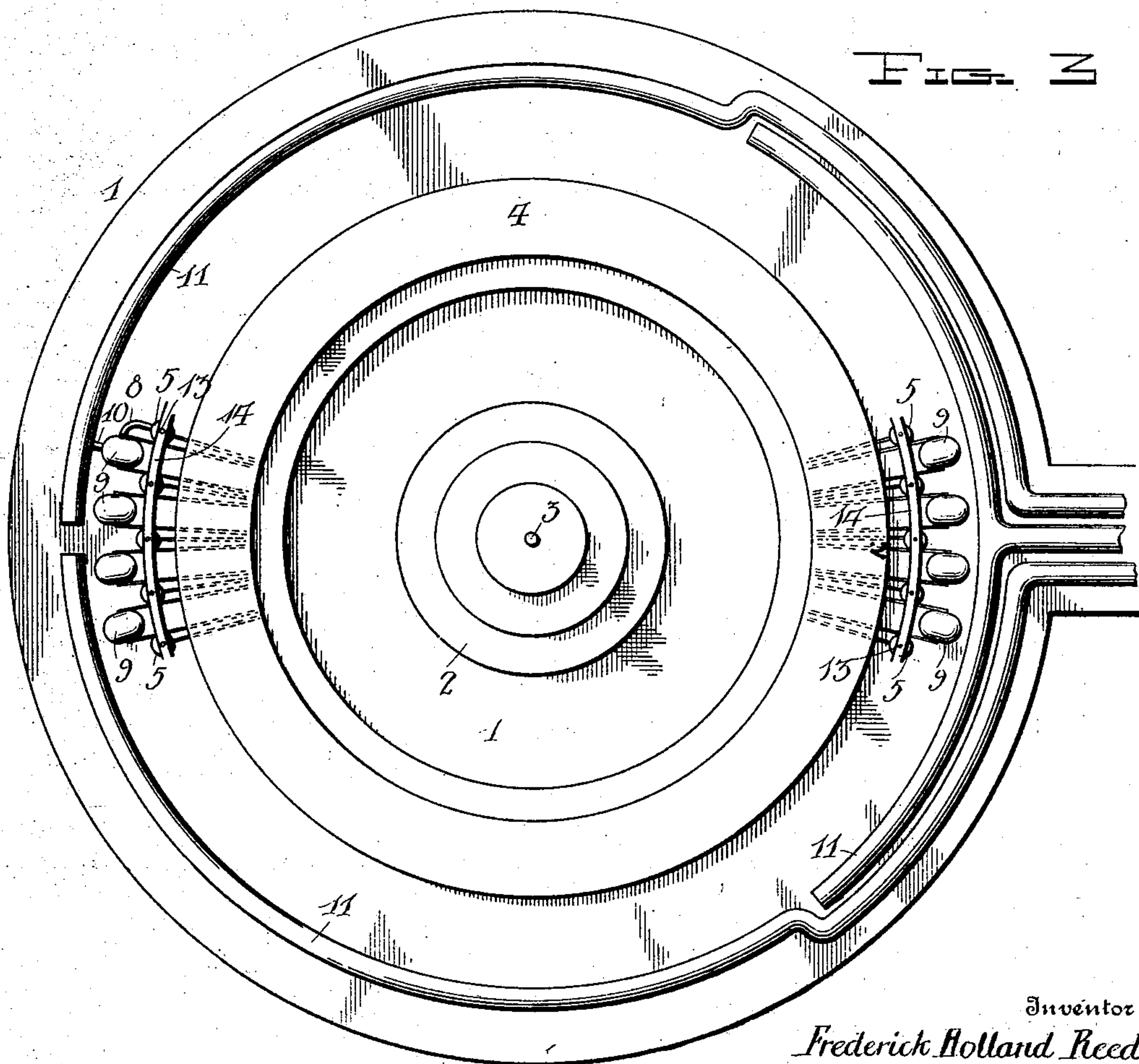


FIG. 3



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4 SHEETS—SHEET 3.

Fig. 5

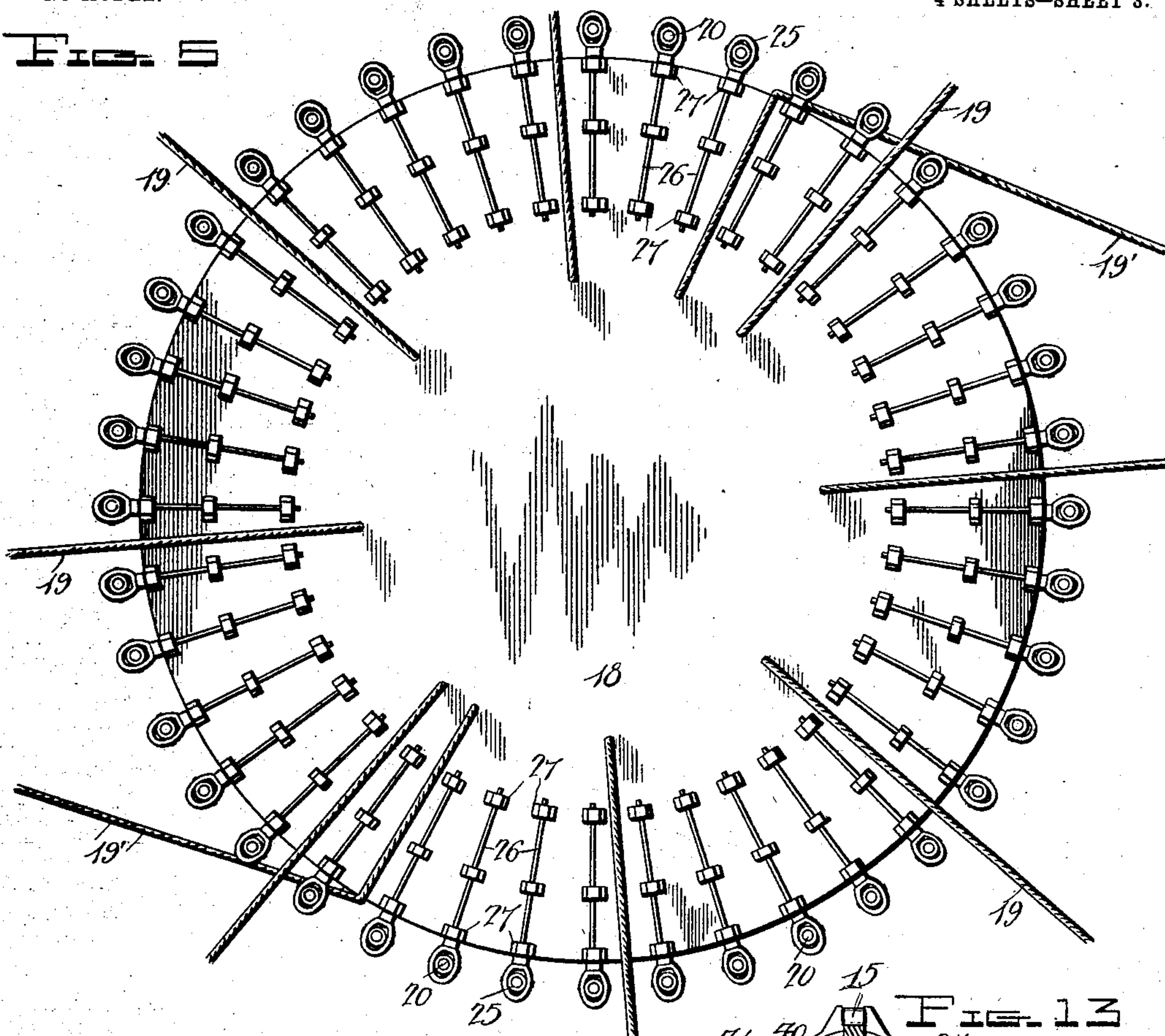
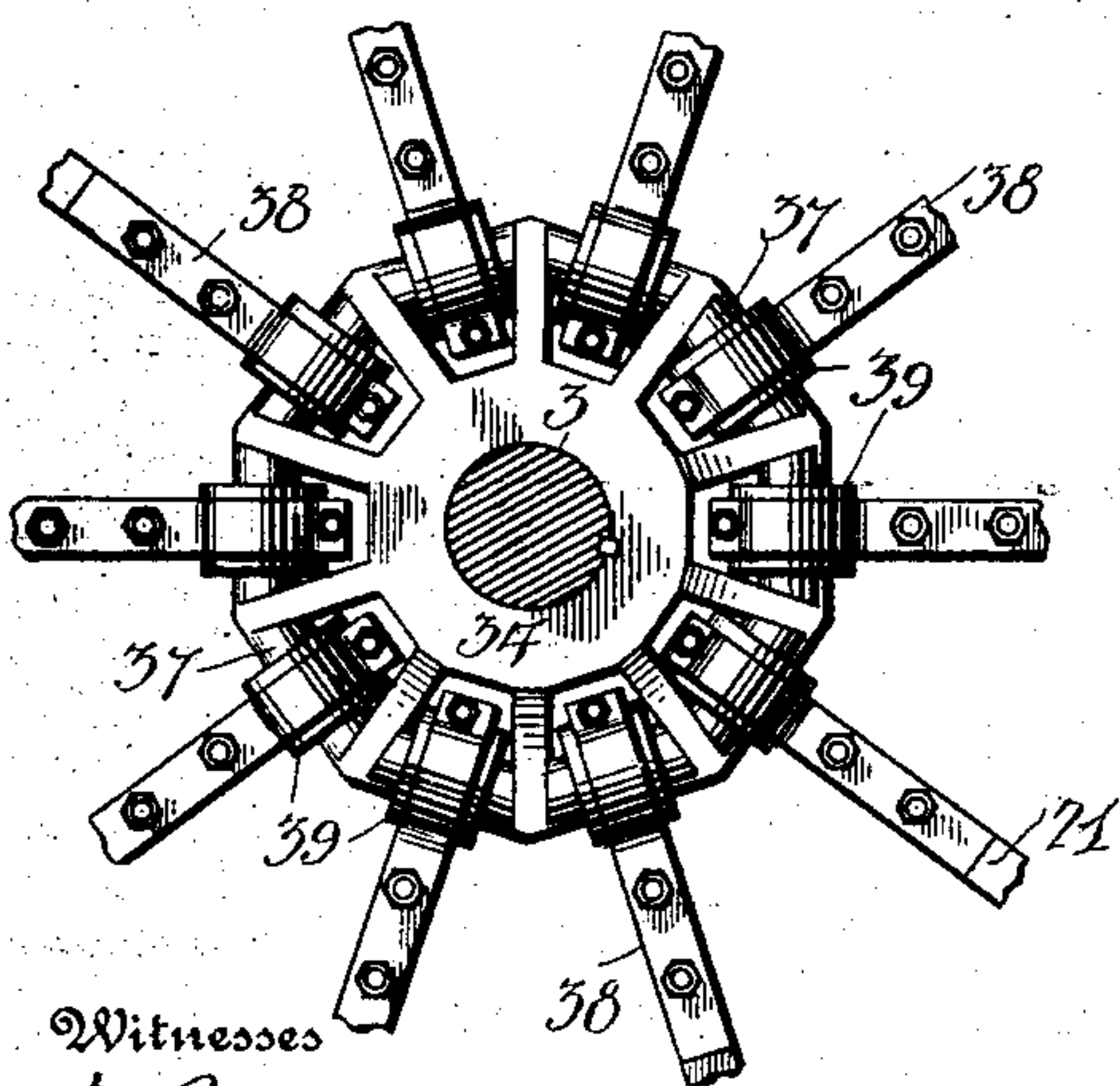
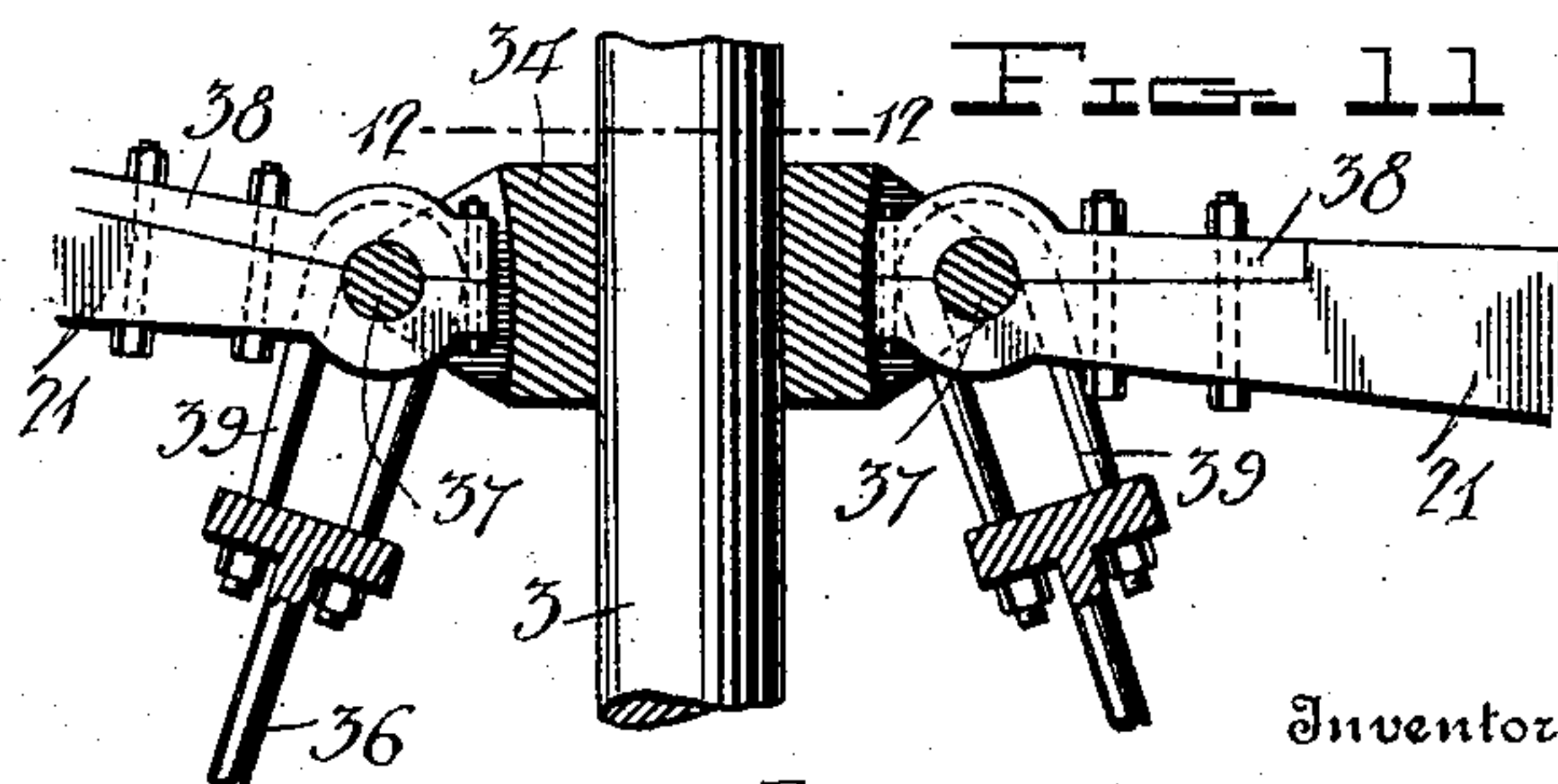
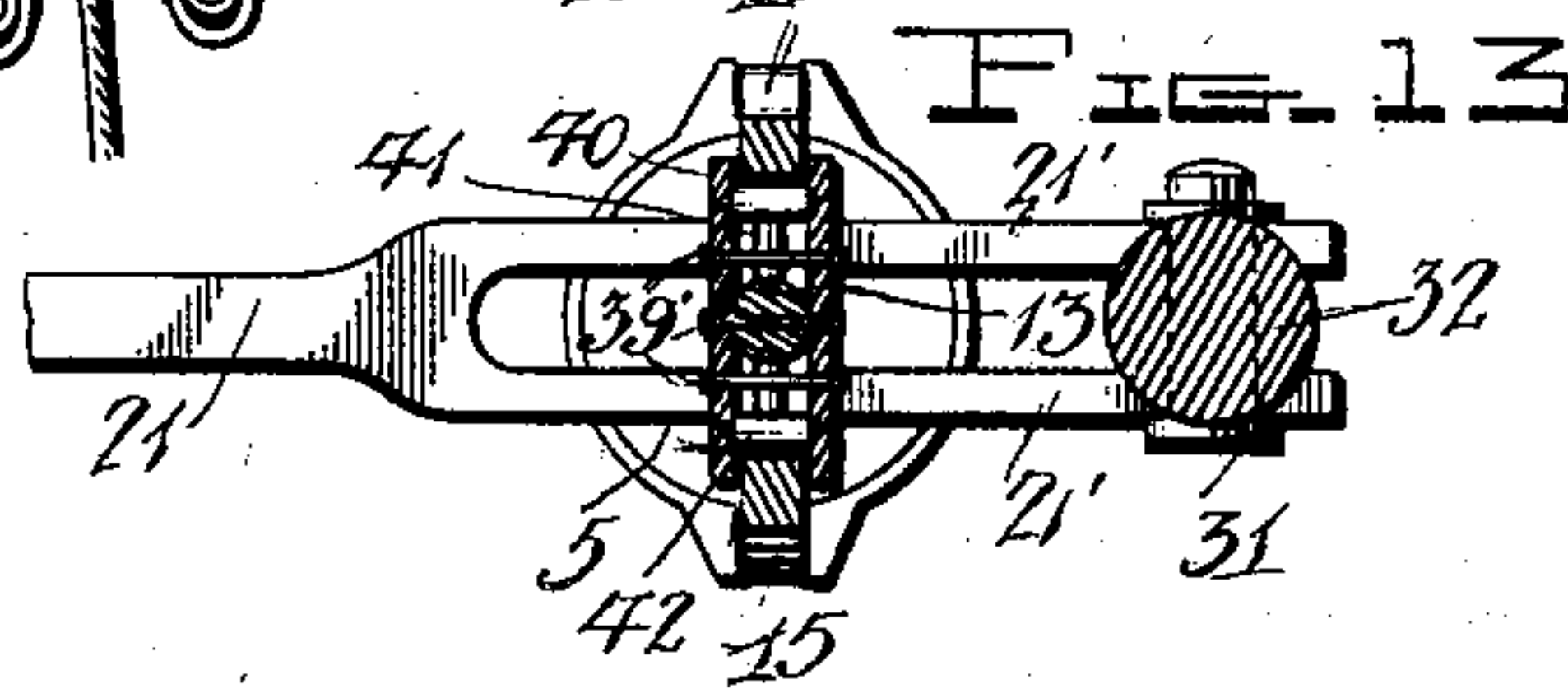


Fig. 12



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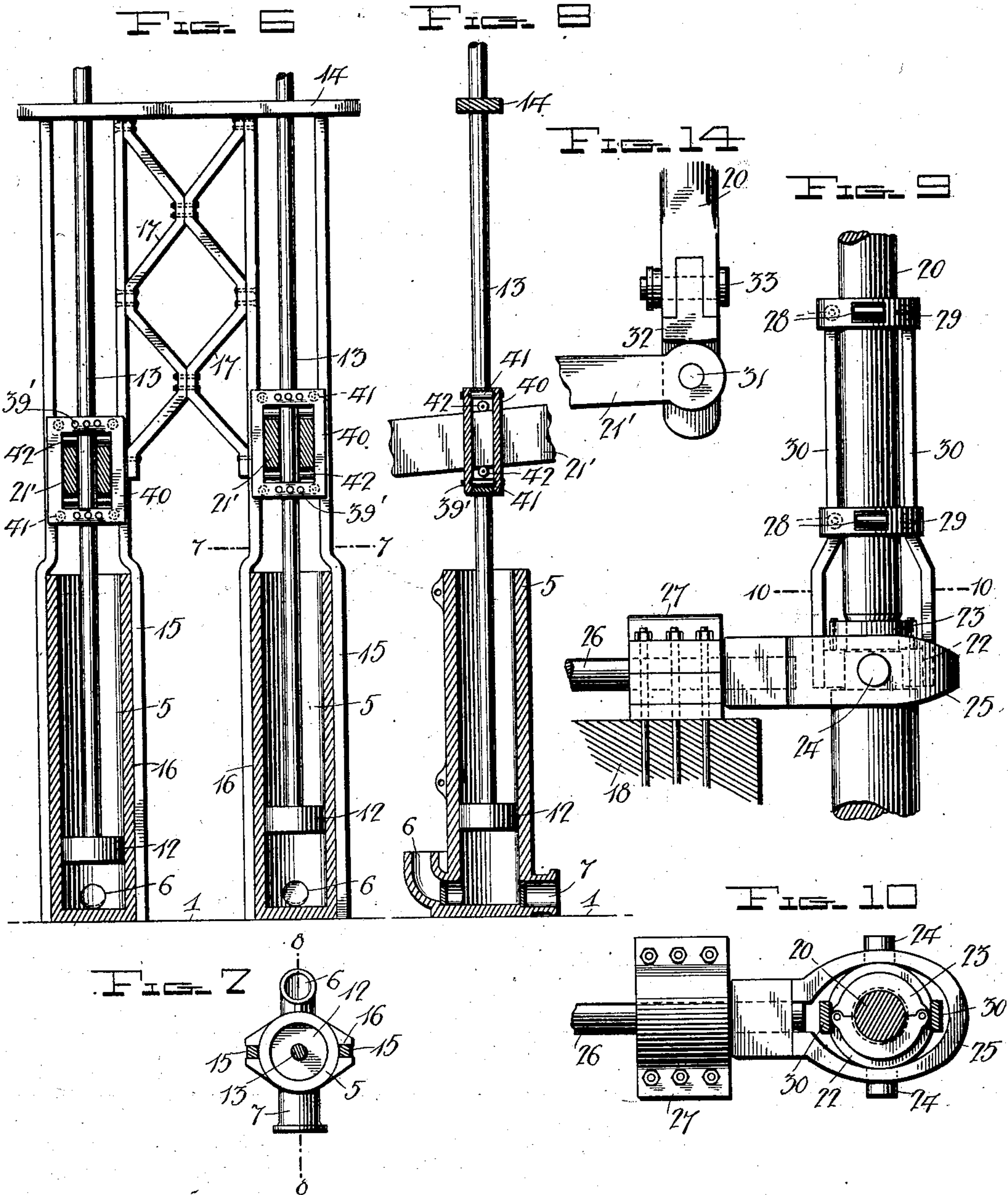
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APPLICATION FILED MAR. 19, 1902.

NO MODEL.

4 SHEETS—SHEET 4.



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UNITED STATES PATENT OFFICE.

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THIRTY-FIVE ONE-HUNDREDTHS TO R. H. F. VARIEL, OF LOS ANGELES,
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WAVE-MOTOR.

SPECIFICATION forming part of Letters Patent No. 721,090, dated February 17, 1903.

Application filed March 19, 1902. Serial No. 99,019. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK HOLLAND REED, a citizen of the United States, residing at Claremont, in the county of Los Angeles, State of California, have invented certain new and useful Improvements in Wave-Motors, of which the following is a specification.

My invention has for its object the production of a comparatively simple apparatus by which wave or swell motion is utilized to lift water to an elevation sufficient to enable its subsequent employment for the generation of power or for other purposes.

The nature of my invention will be readily comprehended, reference being had to the following description of the construction and operation and to the accompanying drawings, illustrating the invention in its preferred form, it being understood that various modifications may be made without departing from the spirit of the invention as defined by the claims.

In the drawings, Figure 1 is a side elevation of a wave-motor embodying my invention. Fig. 2 is a horizontal sectional view on line 2 2 of Fig. 1. Fig. 3 is a top plan view of the foundation structure. Fig. 4 is a vertical central sectional view of the foundation structure. Fig. 5 is an enlarged top plan view of the float or vessel. Fig. 6 is an enlarged detail view, partly in section, showing pumps, guides for the pump-rods, and the pump-rod-actuating means. Fig. 7 is a horizontal sectional view taken on line 7 7 of Fig. 6. Fig. 8 is a vertical sectional view taken on line 8 8 of Fig. 7. Fig. 9 is an enlarged detail view, partly in section, showing the manner of connecting the operating-rods to the float or vessel. Fig. 10 is a sectional view taken on line 10 10 of Fig. 9. Fig. 11 is an enlarged detail vertical sectional view showing the manner of connecting the operating-levers to the center post. Fig. 12 is a sectional view taken on line 12 12 of Fig. 11. Fig. 13 is an enlarged detail view, partly in section, showing the manner of connecting the operating-levers to the operating-rods and pump-rods. Fig. 14 is an enlarged view in elevation, showing the connection between the operating rod and lever.

Referring to the drawings by numerals, 1 denotes the foundation, on which is fastened by anchor-bolts and tie-rods a center base 2, supporting a center post 3. Around the center base is a wall 4, secured to the foundation also by anchor-bolts and tie-rods. The general form of the foundation and superstructure may be and preferably is circular, and the wall 4 is arranged concentrically with reference to the center base and post. The foundation, base, and wall are of suitable material and are constructed with a view to assemblage under water with the expenditure of minimum time and labor. At the outer side of the wall and suitably secured thereto and to the foundation is a concentric series of vertical pump-cylinders 5 5, each having a valved inlet 6 and a valved outlet 7, the latter communicating by a pipe 8 with a cylindrical air-chamber 9, the series of air-chambers being preferably arranged in offset relation to and outside of the series of pump-cylinders. Each of the air-chambers communicates by a pipe 10 with a delivery-pipe 11, which may be common to the whole series of chambers, but which is preferably divided, as shown, into three sections, each receiving water from an equal number of chambers. The pipes deliver the water to a reservoir or other holder elevated a sufficient height to obtain the requisite pressure for the generation of power by a water-wheel for driving engines or motors or for other purposes.

To the piston 12 of each pump is secured a rod 13, slidable toward its upper end in an opening provided therefor in a circular bar or ring 14, which is concentric with the series of pumps and is supported from the pump-cylinders by uprights or guide-bars 15 15. Preferably the lower ends of the uprights occupy recesses 16 16 in the pump-cylinder walls, there being two uprights to each cylinder, and the pairs of uprights are connected together and braced by cross-bars 17 17. The rods 13 are moved to reciprocate the pistons 12 by power transmitted from a preferably circular float or vessel 18, moored by radially-disposed cables or chains 19 19 and occupying a position above and concentric with the series of pumps. The movement of the

float or vessel due to wave or swell motion operates through the medium of rods and levers to actuate the pumps, the indirect connection being necessary owing to the unavoidable lateral and rotative movements of the float or vessel. The float or vessel is provided at intervals corresponding to the locations of the pumps with vertical rods 20, which are pivoted at their lower end to pump-operating levers 21 21. The rods are loosely secured to the float or vessel in the following manner: Each rod toward its upper end is reduced in diameter, providing shoulders, between which are confined a collar 22 and a securing-ring 23, the latter being formed in two hinged parts and having means for locking the free ends thereof. The collar 22 is provided at opposite sides with trunnions 24 24, which occupy openings formed in a yoke 25, fixed to the outer end of a horizontal shaft 26, journaled in bearings 27 27 on the deck of the float or vessel. By this construction the rods 20 are secured toward their upper ends to be incapable of vertical movement with reference to the float or vessel, and consequently follow the rise and fall of the latter; but said rods are allowed sufficient side play at their point of connection to permit independent movement under the lateral and rotative motions of the float or vessel. If it is desired to disconnect all or certain of the pumps—as, for instance, during high seas—the rings 23 are removed, the rods being previously slightly raised and supported by a suitable hoist on the float or vessel, and the rods being vertically free the motions of the float or vessel are not transmitted, the rods remaining practically stationary. To prevent the engagement of the collars 22 with the shoulders on the uncoupled rods in the descent of the float or vessel, the float or vessel may be warped about two points of the compass to deflect the rods from the vertical position, this being accomplished by especially-provided mooring-cables 19' 19', which are tangential to the float or vessel. To reduce friction on the uncoupled rods; rollers 28 28 are employed, said rollers being carried by collars 29 29, fixed to guide-arms 30 30, the arms being secured at their lower ends to the collar 22.

Each lever 21 has its outer end connected to a rod 20 to permit universal movement, the lever end being bifurcated and pivoted by a bolt 31 to a coupling-piece 32, which is pivoted by a bolt 33 to the bifurcated lower end of the rod, the bolts being at right angles to each other. The levers are each pivoted at the inner end to a fulcrum-piece 34 on the center post 3. I have shown the motor provided with forty pumps, though the number may be increased or diminished, dependent upon the desired capacity. Four fulcrum-pieces are preferably provided for the forty levers, each piece serving as the fulcrum for ten levers, as shown more particularly in Fig. 12. The fulcrum-pieces are keyed to the cen-

ter post to prevent rotation and are firmly secured by a nut 35, screwed on the upper end of the center post, or by other suitable means. The lower fulcrum-piece is preferably further secured by stay-rods 36, which extend through the center base 2. Each fulcrum-piece is provided with the requisite number of fulcrum-bearings 37, circular in cross-section, for the inner ends of the levers, which are equipped with removable bearing-caps 38 for convenience in assemblage. Flanking each lever end and encircling the bearings of the lower fulcrum-piece are straps 39 39, which are bolted or otherwise secured to the stay-rod 36. (See Fig. 11.) The levers are connected to the pump-rods near their outer end, and therefore adjacent to the connection with the rods 20. Secured to each pump-rod, preferably by bolts 39' 39', is a frame 40, carrying rollers 41 41, which engage the inner sides of the uprights or guide-bars 15 15. The levers are, as before stated, bifurcated, and the ends 21' 21' extend through openings in the frame 40 and flank the pump-rod. Rollers 42 42, carried by the frame, engage the lever above and below, providing a practically frictionless connection between the lever and rod and permitting the necessary play. The employment of the rollers between the frame and uprights insures proper guiding of the pump-rod with the minimum of friction.

In the installation of the motor due regard is had to the existing conditions at the locality, the foundation being positioned at a suitable depth below the surface, dependent upon the presumed height of the waves or swell to be utilized and the maximum change of surface elevation due to tides.

In operation as the float or vessel under the action of the waves or swell rises the rods 20 are lifted to the same extent as the contiguous side of the vessel to which they are connected, and through the medium of the corresponding levers the pump-rods are moved to elevate the pistons and permit the pumps to fill with water. As the surface subsides the vessel is depressed by gravity acting with a force commensurate with the displacement of the vessel, which force is of constant quantity and not dependent upon the degree of movement of the float or vessel. The depression of the float or vessel operates to move the pistons downwardly, forcing the water from the pumps and through the air chambers and pipes to a reservoir or other holder located, preferably, on shore at the proper elevation for its subsequent use in the manner previously stated. My invention also contemplates the operation of the pumps to lift the water on the rise of the float or vessel and, further, of utilizing the pumped water directly as the medium of power. I prefer, however, to provide for an accumulation of water in a reservoir or other holder, as in that way the power derived is rendered uniform. The pump-cylinders will have a length corre-

sponding with the sum of height of the highest waves or swells and with the range of tides.

It will be noted that in the construction employed rigidity is avoided and that the connections are so made as to allow for a very considerable play to conform to the lateral and rotative movements or thrusts of the float or vessel. The parts and connections are, however, strongly made, and therefore durable and not liable to disorder.

As previously stated, I prefer to so construct the foundation and parts supported thereby as to enable their assemblage below water with the minimum of time and labor, thereby insuring economy of installation.

I claim as my invention—

1. A wave-motor consisting of a series of force-pumps, a pump-operating float or vessel moored to permit a rocking or a uniform rise-and-fall movement under wave or swell action, and detachable connections between the float or vessel and force-pumps.

2. A wave-motor consisting of a float or vessel moored to permit a rocking or a uniform rise-and-fall movement under wave or swell action, a series of rods extending from the float or vessel and detachably connected thereto to have a universal movement, and a series of force-pumps operatively connected to said rods.

3. A wave-motor consisting of a float or vessel, a series of force-pumps beneath the same, rods depending from the float or vessel, means for coupling and uncoupling the rods to the float or vessel, roller-bearings for the uncoupled rods, and a series of levers connected with the rods and pump-rods.

4. A wave-motor consisting of a float or vessel, a series of force-pumps beneath the same, a series of rods depending from the same, frames carried by the pump-rods, a series of levers extending through the frames and connected with the rods, and rollers carried by the frames and engaging the levers.

5. A wave-motor consisting of a float or vessel, a series of force-pumps beneath the same, a series of rods depending from the same, frames carried by the pump-rods, guides for the frames, rollers between the guides and

frames, a series of levers fulcrumed at their inner end and extending through the frames and connected by a universal joint with the lower end of the rods, and rollers carried by the frames and engaging the levers.

6. A wave-motor consisting of a float or vessel having radially-disposed mooring-cables and tangential mooring-cables for the purpose set forth, a series of rods depending from the float or vessel, means for coupling and uncoupling said rods, and a series of force-pumps beneath the float or vessel and operated by said rods.

7. A wave-motor consisting of a float or vessel, a continuous series of rods depending from the same, a continuous series of force-pumps beneath the vessel, levers connecting the rods and pump-rods, air-chambers connected with the pumps and delivery-pipes connected with the air-chambers and discharging at an elevation above the motor.

8. A wave-motor consisting of a float or vessel, a series of horizontally-mounted rotatable shafts on the same, a series of vertically-disposed rods loosely connected with the shafts, a series of force-pumps beneath the float or vessel, and levers connecting the rods with the pump-rods.

9. A wave-motor consisting of a float or vessel, a series of rods connected to and depending from the same, a stationary foundation beneath the float or vessel having a center post, a series of force-pumps fixed to the foundation, and a series of levers fulcrumed on the post and connected to the rods and pump-rods.

10. A wave-motor consisting of a moored circular float or vessel, a foundation beneath the same, a circular series of pumps on the foundation, rods connected to and depending from the float or vessel, and radially-disposed levers fulcrumed centrally of the series of pumps and connecting the rods with the pump-rods.

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