No. 806,124. PATENTED DEC. 5, 1905.

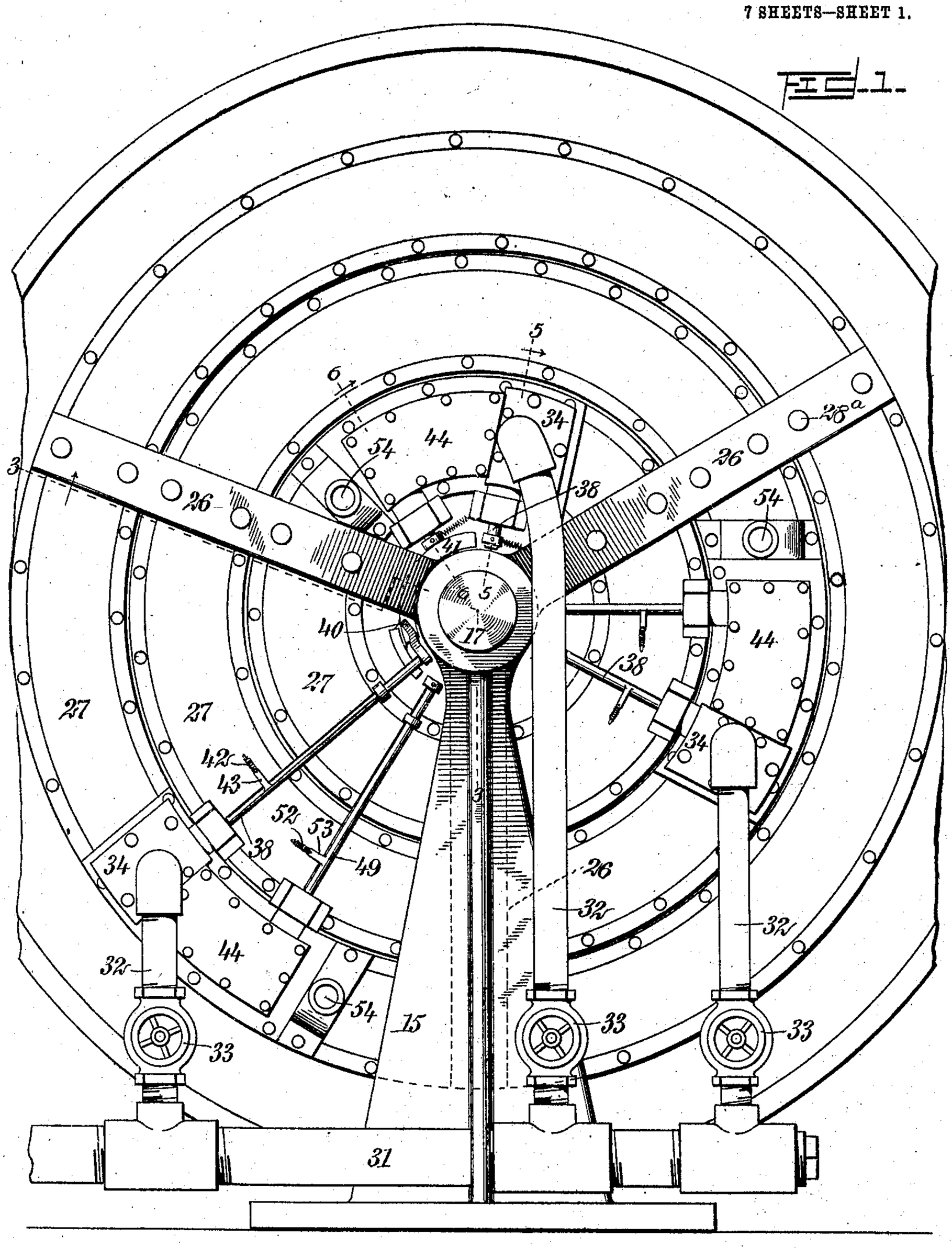
J. M. ELLSWORTH.

ROTARY ENGINE.

APPLICATION FILED MAR. 24, 1905.

7 SHEETS—SHEET 1.

FIG. 1.



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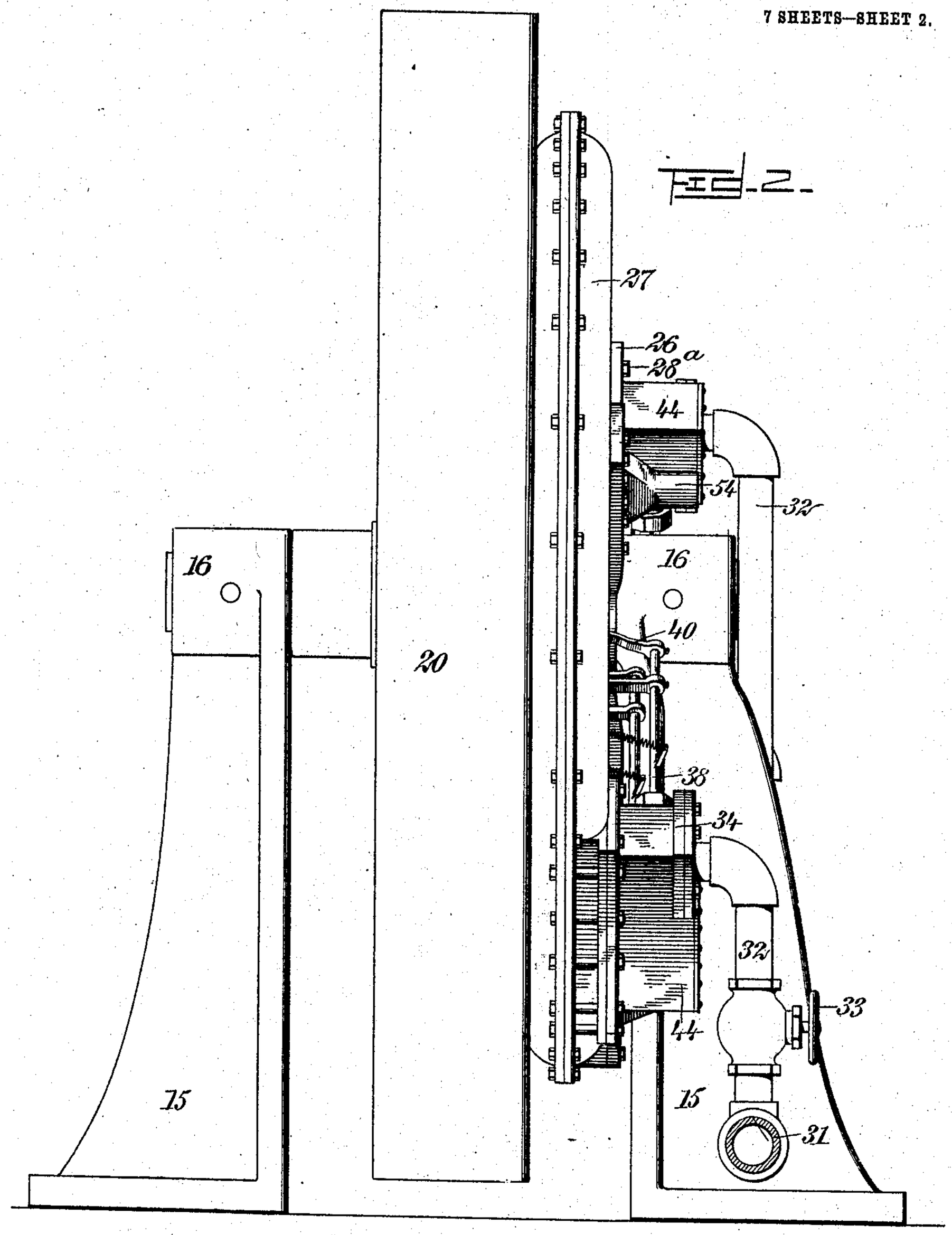
7 SHEETS—SHEET 2.

FIG. 2.



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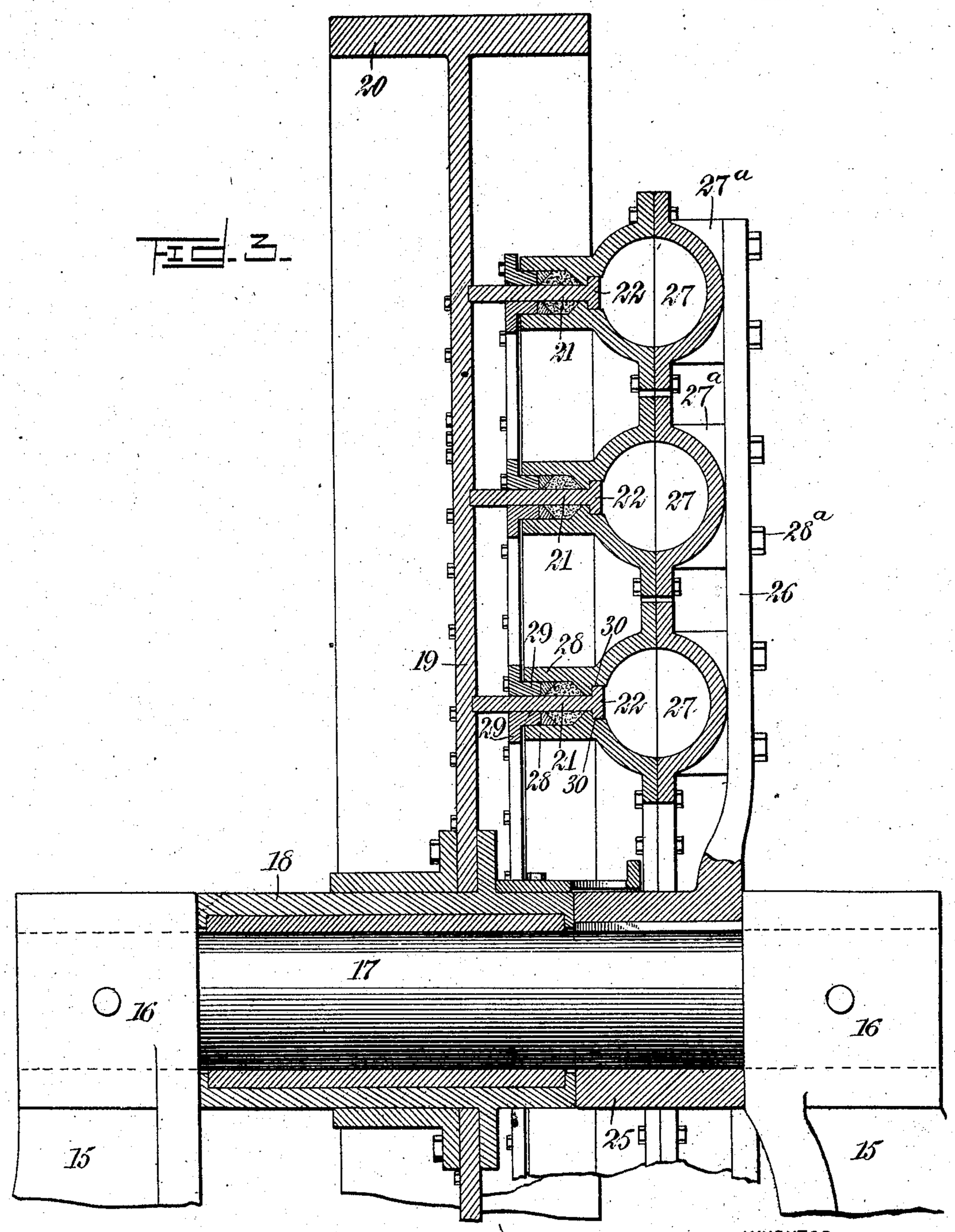
7 SHEETS—SHEET 3.

FIG. 3.



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7 SHEETS—SHEET 4.

FIG. 4.

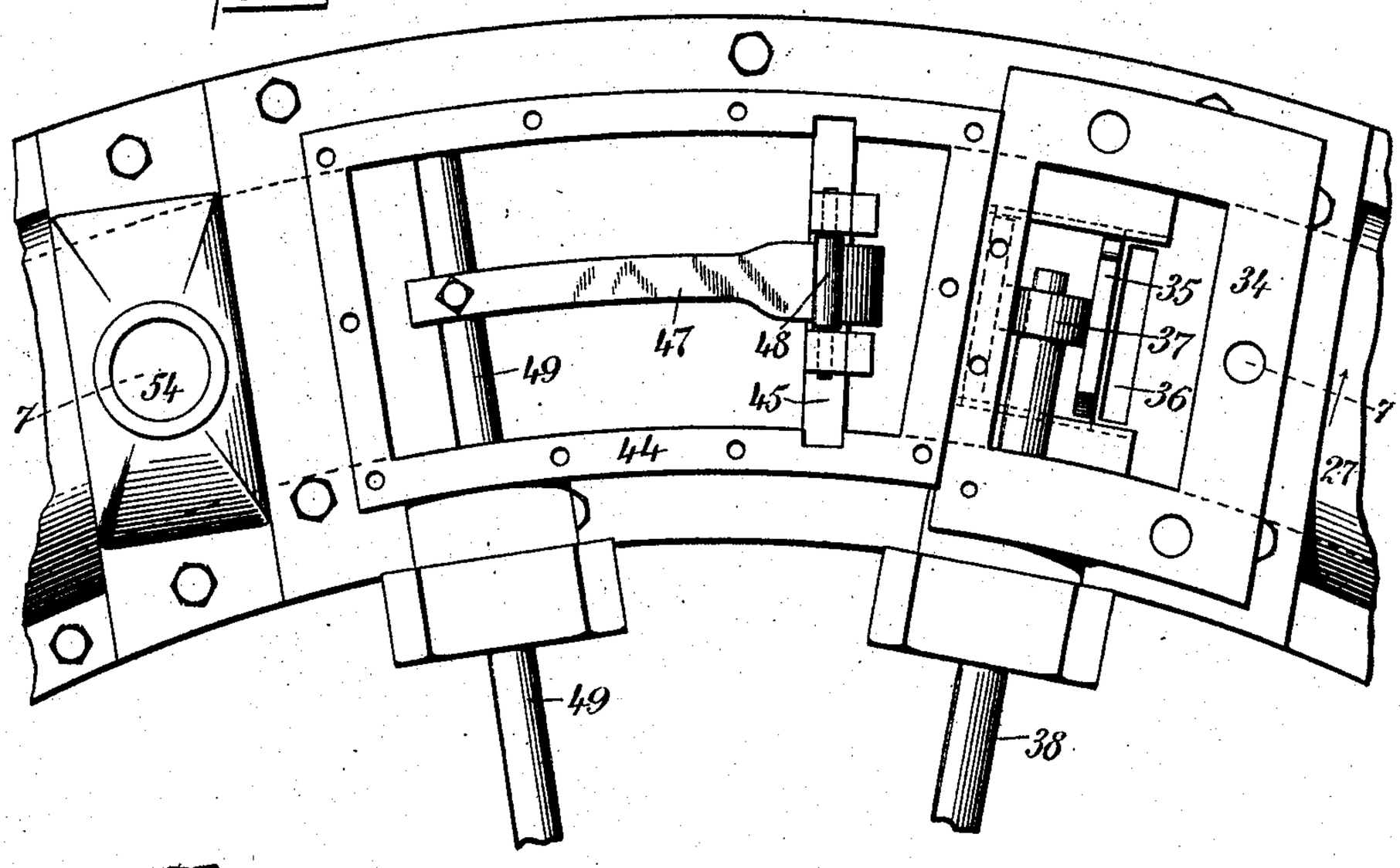


FIG. 8.

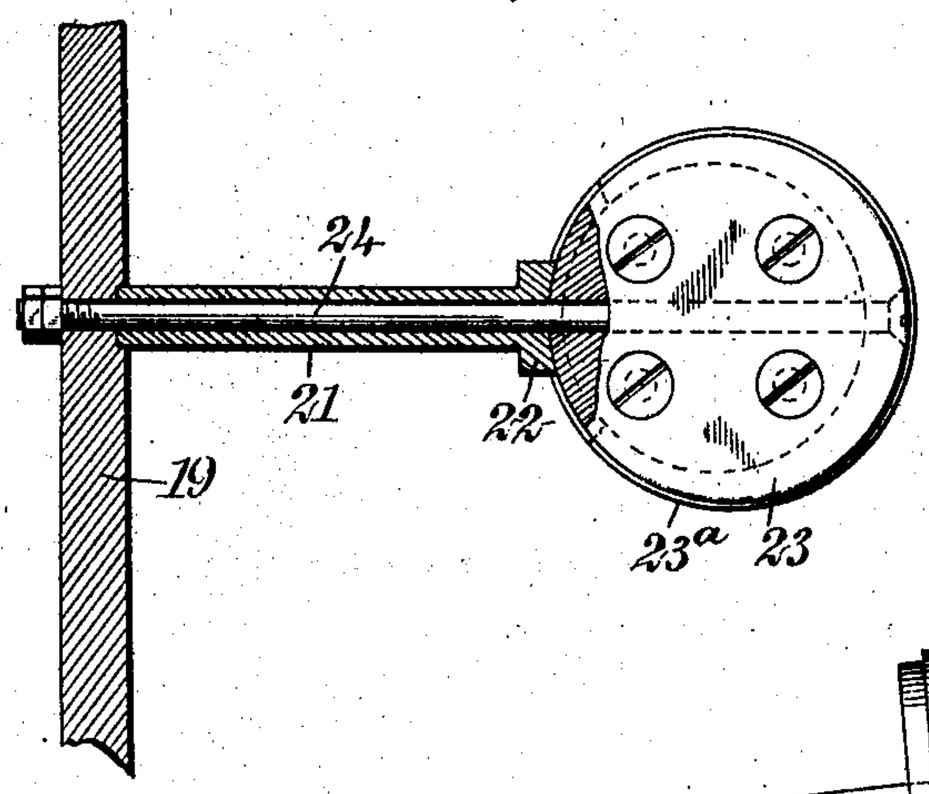
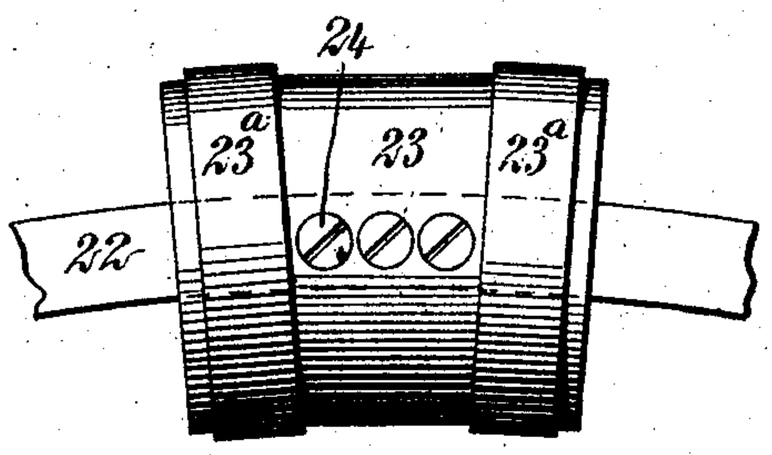


FIG. 9.



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7 SHEETS—SHEET 5.

FIG. 5.

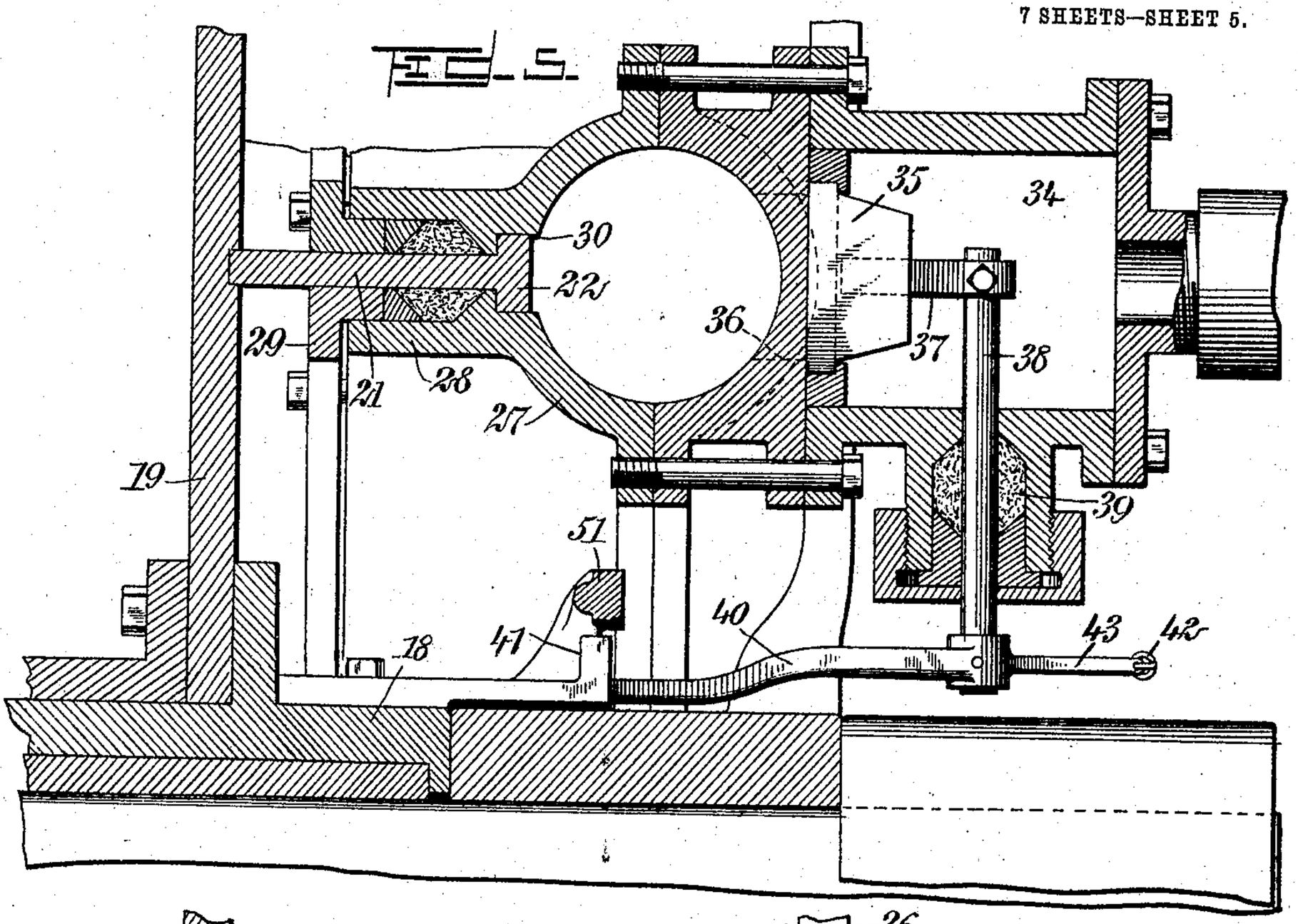
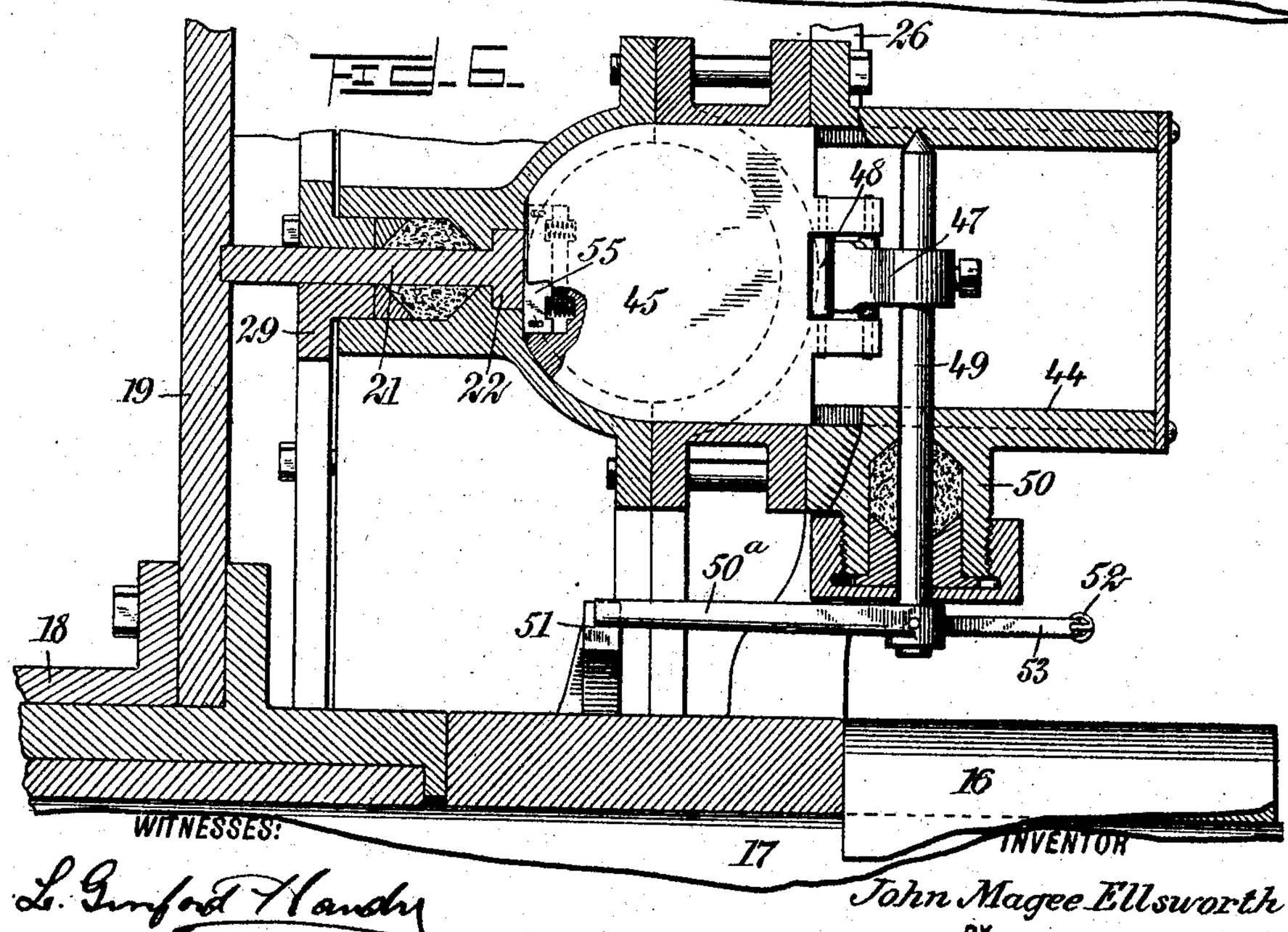


FIG. 6.



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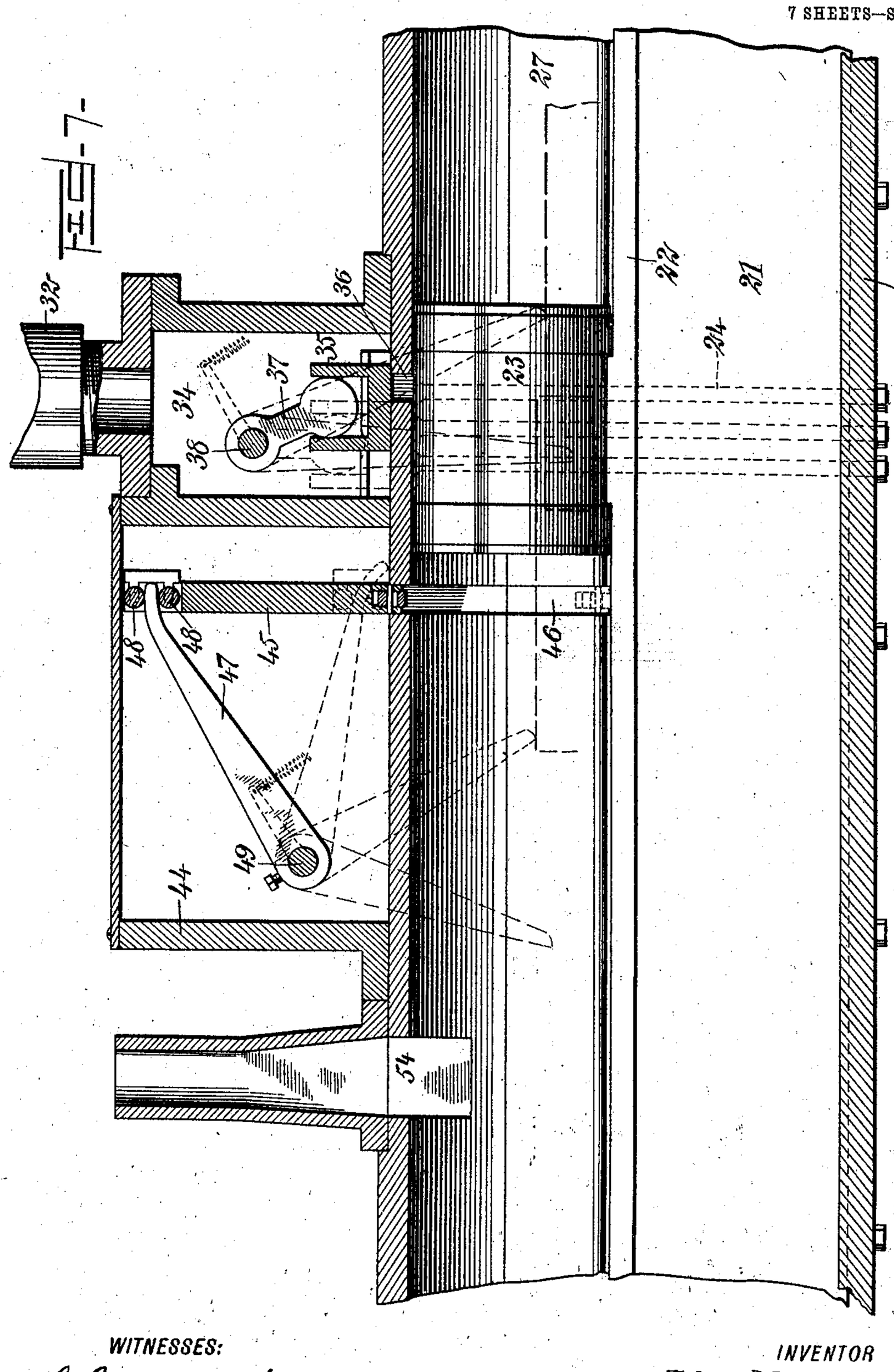
APPLICATION FILED MAR. 24, 1905.

7 SHEETS—SHEET 6.



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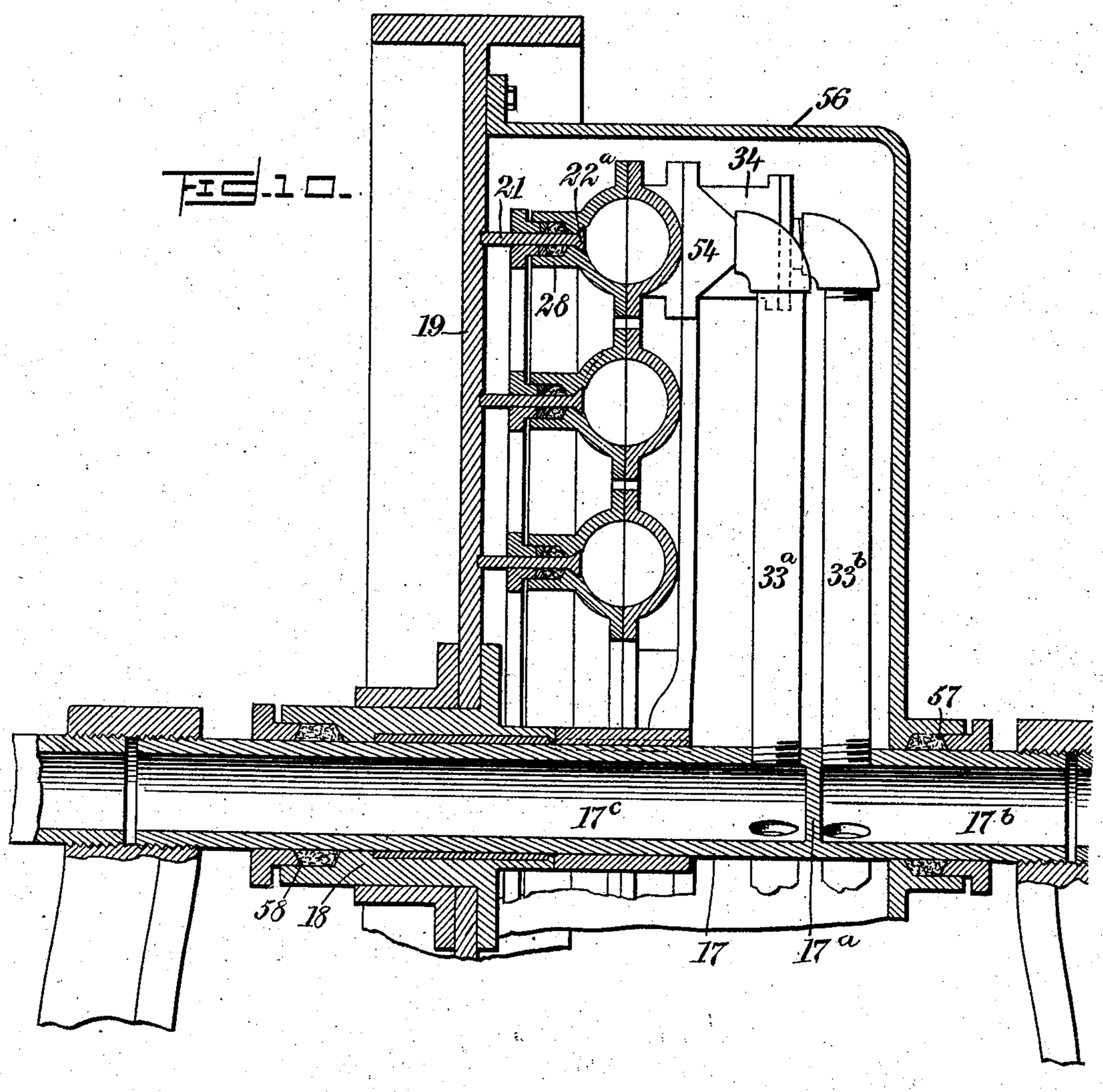
7 SHEETS—SHEET 7.

FIG. 10.



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UNITED STATES PATENT OFFICE.

JOHN MAGEE ELLSWORTH, OF NEW YORK, N. Y.

ROTARY ENGINE.

No. 806,124. Specification of Letters Patent. Patented Dec. 5, 1905.

Application filed March 24, 1905. Serial No. 251,840.

To all whom it may concern:

Be it known that I, JOHN MAGEE ELLSWORTH, a citizen of the United States, and a resident of the city of New York, borough of Manhattan, in the county and State of New York, have invented a new and Improved Rotary Engine, of which the following is a full, clear, and exact description.

The invention relates particularly to a rotary engine intended to be operated by steam or other elastic fluid; but I desire it understood that by a change in the manner of operating the apparatus it may be employed as a pump or compressor, either use being within the purview of my invention.

In its preferred embodiment my improved apparatus comprises one or more circular cylinders, in which operate pistons intended to move continuously through the circular cylinder or cylinders around a common axis. These pistons are connected with the rotating element of the motor from which its power is taken, and coacting with the circular cylinders are peculiar means for controlling the steam supply and distribution.

Reference is to be had to the accompanying drawings, which illustrate as examples two forms in which my invention may be practically embodied, in which drawings like characters of reference indicate like parts in the several views, and in which—

Figure 1 is an end elevation of the motor, showing the periphery of the rotary part of the same, the circular cylinders, the steam-supply pipes, and the valve-chests. Fig. 2 is a side elevation of the same. Fig. 3 is an irregular section on essentially the line 3 3 of Fig. 1. Fig. 4 is an enlarged plan view showing the exhaust-port, abutment, and valve of one of the cylinders, this view illustrating the valve and abutment chests with their covers removed to expose the interior parts. Fig. 5 is a section on the line 5 5 of Fig. 1, partly showing one of the steam-valves and its operating device. Fig. 6 is a section on the line 6 6 of Fig. 1, showing one of the abutments and its operating means. Fig. 7 is a section on the line 7 7 of Fig. 4. Fig. 8 is a view showing one of the pistons and illustrating in section the circular rib by which the same is carried and part of the rotating plate or wheel of the motor. Fig. 9 is a top view of the piston, showing it attached to its circular or annular rib; and Fig. 10 is a view corresponding to Fig. 3, showing a slightly-modified form of the invention.

Referring first to Figs. 1 to 9, the engine is mounted on a frame composed of pedestals 15, having boxes 16 at their upper ends, in which is fastened rigidly a shaft 17. On this shaft is revolubly mounted the hub 18 of the rotor of the motor, which comprises in addition to the hub a disk-like plate or web 19 and a rim 20. The parts 18, 19, and 20 in the form illustrated constitute a wheel, and this may, if desired, be utilized as a band-wheel from which to take the power of the motor, or the rotor may be provided with any desired means for transmitting its motive power. Fastened to the web 19 of the rotor by tie-bolts or any other desired means are annular ribs 21. As here shown, these ribs are three in number, and they are arranged concentric to each other and to the axis around which the rotor revolves. The ribs are formed with T-heads 22 at their outer edges, and attached to the outer edge of each rib is a piston 23. The pistons 23 are provided with suitable packing-rings 23^a and are fastened in place by tie-bolts 24, which preferably pass through the pistons, ribs 21, and web 19, as shown best in Figs. 8 and 9. Therefore the annular or circular ribs 21 and their attached pistons 23 turn with and form virtually a part of the rotor of the engine.

Secured on the shaft 17 alongside of the hub 18 of the rotor is a collar 25. From this collar rigid spider-arms 26 project, as shown best in Fig. 1. These spider-arms 26 form part of the frame of the engine, and they carry the circular or annular cylinders 27. As here shown, there are three of these cylinders, one for each of the ribs 21 and pistons 23. Said cylinders are formed of two sections flanged and bolted together, as shown best in Fig. 3, and one section of each cylinder is provided with a block or enlargement 27^a, which blocks or enlargements engage the spider-arms 26.

28^a (see Figs. 1, 2, and 3) indicate tie-bolts which pass through the spider-arms and through the enlargement 27^a, thus rigidly fastening the cylinders 27 to the arms 26. Said cylinders are concentric to the center of revolution of the rotor, and each cylinder is provided with annular flanges 28. (Shown best in Fig. 3.) These flanges are spaced from each other and extend continuously around

the engine, forming the equivalents of a stuffing-box. Coacting with said flanges are annular flanges 29, T-shaped in cross-section and bolted or otherwise secured to the flanges 28, forming equivalents of glands. In the annular spaces between the pairs of flanges 28 and 29 the annular ribs 21 are loosely received, a steam-tight connection being made between the flanges 28 and ribs 21 by means of packing at each side of the ribs between the flanges, as the drawings illustrate. The cylinders 27 are also formed with annular grooves 30, and in these grooves the T-heads 22 of the annular ribs 21 are loosely received. This forms an essentially steam-tight joint, and at the same time it allows for the running movement of the ribs 21 between the parts 28 and 29 with minimum friction between the engaging surfaces. The pistons 23 fit snugly within their respective cylinders, and, as shown best in Fig. 9, the pistons are formed on arcs of the circles of their respective ribs 21, so as to permit effective engagement between the pistons and the cylinder-walls and allow for the free movement of the pistons continuously through the cylinders.

As shown best in Figs. 1 and 2, the steam or other motive-fluid main 31 has a branch 32 for each cylinder 27. 33 indicates globe-valves commanding said branches 32. The branches of the motive-fluid-supply main 31 pass, respectively, to valve-chests 34, which are carried one by each of the cylinders 27.

As shown best in Figs. 4, 5, and 7, the valve-chests 34 each carry a slide-valve 35, these valves controlling the steam movement through ports 36 into the cylinders 27. Said valves are engaged by rocker-arms 37, attached to rock-shafts 38. The shafts 38 extend through the side walls of the valve-chests 34, stuffing-boxes 39 being provided to effect steam-tight connection.

As shown in Figs. 1 and 5, the various rock-shafts 38 extend radially inward toward the center of the motor and are provided at their inner ends with arms 40. These arms are adapted to be engaged by arc-shaped cams 41, attached to and turning with the hub 18 of the rotor. Springs 42 are connected with the rock-shafts 38 by means of arms 43, as shown. Said springs tend to throw the valves 35 in one direction, (according to the present embodiment to throw the valves into open position,) and the fingers 40 and cams 41 act to throw the valves in the opposite direction, (in the present instance to closed position.) It is clear, therefore, that by properly proportioning the cams 41 said cams may be made to move to normally throw the slide-valves 35 to closed position, thus cutting off the steam-supply at any desired point.

Fig. 7 shows one of the valves 35 in closed position and illustrates the corresponding piston 23, passing under the port 36. As soon as said piston clears the port the cam 41 should be arranged to ride from under the corresponding finger 40, permitting the corresponding spring 42 to open the slide-valve 35, so that steam then passes into the cylinder. The entering steam acts by impact until the cam 41 strikes the finger 40, whereupon the sliding valve is closed and the expansive action of the steam begins.

Adjacent to each valve-chest 34 is an abutment-chest 44, these chests 44 being attached to or mounted on the cylinders 27, as shown best in Fig. 1. In each chest 44 is arranged an abutment 45, and these abutments are adapted to slide through ways 46, across the respective cylinders 27, so as to form a wall against which the pressure of the motive fluid may be exerted during the time that said fluid is acting to drive the piston. The abutments 45 of each cylinder are normally held in the active positions indicated by full lines in Fig. 6 and broken lines in Fig. 7, and they are periodically moved out of the cylinders, as indicated by full lines in Fig. 7, so as to allow the pistons 23 to pass the abutments at the end of the power-stroke of each piston. According to the embodiment of the invention illustrated for the purpose of so operating the abutments 45 I provide fingers 47, engaging between rollers 48, suitably mounted on the abutments. Said fingers 47 are located between the abutment-chests 44 and are attached to rock-shafts 49. The rock-shafts 49 pass through the side walls of the chests 44, stuffing-boxes 50 being provided, if desired, to make a steam-tight connection, and said rock-shafts extend inwardly toward the center of the engine, as shown in Fig. 1. Each of the three rock-shafts 49 is provided with an arm 50^a, and these arms are adapted to be struck by tappets 51, attached to and rotating with the hub 18. The shafts 49 are actuated by springs 52, connected with the shafts by short arms 53. Said springs tend to hold the abutments in their inward or active position, as shown by full lines in Fig. 6 and broken lines in Fig. 7, and the tappets or cams 51 serve periodically to move the abutments outward, the cams or tappets being so placed to bring about the outward movement of the abutments the instant that the corresponding pistons approach the abutments.

54 indicates the exhaust-ports from the cylinders 27. These ports are located directly adjacent to the abutments 45 at the sides opposite the steam-ports 36. The exhaust-ports 54, as shown in Figs. 1 to 9, are arranged to discharge directly into the atmosphere. It is obvious, however, that devices of any desired sort may be employed to conduct the exhaust-steam or other fluid away from the engine. The abutments 45 are provided with suitable packing-strips 55, adapted to engage the T-heads 22 of the annular ribs 21, so as to ef-

fect steam-tight connection with these parts when the abutments are in their inward or active position.

In the operation of the engine steam or other motive fluid is admitted to the valve-chests 34 through the main pipe 31 and branch pipes 32. This steam will pass through such of the ports 36 as are not covered by their valves 35 and in entering the cylinder or cylinders 27 will act on the pistons 23 to impart movement to the rotor of the engine. Upon the beginning of this movement the automatic operation of the valves and abutments begins and the action of the engine becomes normal, the steam acting on the piston continuously throughout the rotation of the motor excepting for the small arc between the exhaust-port 54 and inlet-port 36. It will thus be seen that the impulse imparted by the piston is practically continuous, and it will therefore be apparent that by regulating the form and proportions of the cam 41 the steam may be cut off at any desired point, utilizing the expansive action of the steam from this point on to the exhaust. It is also pointed out that by providing the separate cylinders and the supply branches 32 steam may be supplied independently to the cylinders, operating the engine under all or any one of the cylinders, as may be desired, the valves 33 being employed to control the steam-supply in this respect.

Referring to Fig. 10, which shows a modification of my invention, the shaft 17 is formed hollow, with a transverse dividing-wall 17^a therein, producing a steam-supply passage 17^b and a steam-exhaust passage 17^c. With these passages supply and exhaust pipes 33^a and 33^b communicate. The supply-pipes 33^b lead to the valve-chest 34, while the exhaust-pipes 33^a lead from the exhaust-ports 54 before described. Fastened to the web 19 of the rotor is an inclosing wall 56, which is hermetically joined to the web and passes outward and thence inward, where it is connected with the shaft 17 by a stuffing-box 57. This wall 56 turns with the rotor of the engine and incloses the cylinders, steam-pipes, valves, abutments, and their operating-gears. The hub 18 of the rotor is provided at its outer side with a stuffing-box 58, as shown. This arrangement forms a steam-tight inclosure for the cylinders, so that if the motive fluid should leak past the flanges 28 it will be restrained within the inclosure and eventually will equalize with the pressure in the cylinders. Upon this equalization of pressures leakage will be stopped and a saving in the motive fluid thus attained. The modified arrangement is also useful in case the invention is used as a pump or compressor, at which time the space inclosed by the wall 56 and the web 19 could be filled with a cooling fluid, so as to reduce the temperature around the cylinders due to the compression therein. In the construction shown in Fig. 10 the heads 22^a of the ribs 21 are shown with beveled edges instead of the square edges illustrated in the other figures of the drawings. This construction allows the steam or other pressure within the cylinder to force the heads 22^a outward, causing the heads to seat firmly and preventing leakage at this point.

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

1. The combination of a central shaft, a rotor mounted thereon, a plurality of concentric annular ribs attached to the rotor, a piston attached to each rib, annular cylinders having openings extending throughout the same in which openings said ribs are loosely fitted, the pistons working within the cylinders, means for mounting the cylinders, and means for controlling fluid movement in the cylinders.

2. The combination of a central shaft, a rotor mounted thereon, a plurality of concentric annular ribs attached to the rotor, a piston attached to each rib, annular cylinders having openings extending throughout the same in which openings said ribs are loosely fitted, the pistons working within the cylinders, means for mounting the cylinders, means for controlling fluid movement in the cylinders, and means for packing the connection between the ribs and the cylinders.

3. The combination of a stationary shaft or support, a rotor mounted thereon, an annular rib attached to the rotor, a piston attached to the rib, an annular cylinder having an opening extending throughout the same in which opening the rib is loosely received, a piston operating within the cylinders, means for packing the connection between the rib and cylinder, an arm rigidly mounted on the said shaft and fastened to the cylinder to support the same, and means for controlling fluid movement within the cylinder.

4. The combination of a rotor, a plurality of pistons in connection therewith, a plurality of concentric cylinders through which the pistons are respectively adapted to move, means for mounting the rotor, means for mounting the cylinders, and independent operative means controlling fluid movement in said cylinders.

5. The combination of an annular cylinder having an opening extending throughout the same, a rib fitting loosely in the opening in the cylinder, a piston attached to the rib and working in the cylinder, means for controlling fluid movement to and from the cylinder, and means for forming a fluid-tight inclosure for said parts.

6. The combination of a rotor, an annular rib attached thereto, a piston attached to the rib, an annular cylinder having an opening extending around the same, the rib being loosely received in the opening and the piston

operating within the cylinder, means controlling fluid movement to and from the cylinder, and a hood attached to the rotor and forming with the rotor a fluid-tight inclosure for the cylinder.

7. The combination of a central shaft having admission and exhaust passages therein, a rotor arranged to turn around the shaft, an annular rib attached to the rotor at one side, a piston carried by said rib, an annular cylinder having an opening extending around the same, said opening loosely receiving the said rib and the piston operating within the cylinder, means controlling fluid movement to and from the cylinder, said means communicating respectively with the admission and exhaust passages of the shaft, and a hood attached to the side of the rotor having said rib, the hood inclosing the cylinder and including the shaft to form a fluid-tight inclosure for the cylinder.

8. In a rotary engine, the combination of a shaft, a rotating disk or wheel mounted thereon, an annular rib attached to the side of the disk and disposed concentrically to the center of rotation thereof, a piston attached to said disk, an annular cylinder having an opening extending around the same into which opening said rib is loosely fitted, the piston working in the cylinder, packing acting between the cylinder and rib, and means for controlling the admission and exhaust of the motive agent.

9. In a rotary engine, the combination of a shaft, a rotating disk or wheel mounted thereon, an annular rib attached to the side of the disk and disposed concentrically to the center of rotation thereof, a piston attached to said disk, an annular cylinder having an opening extending around the same into which opening said rib is loosely fitted, the piston working in the cylinder, packing acting between the cylinder and rib, means for controlling the admission and exhaust of the motive agent, said means comprising an abutment movable in and out of the cylinder, the cylinder having admission and exhaust ports respectively at the sides of the abutment, a valve controlling the admission-port, and devices for operating the valve and abutment in unison with the movement of the piston.

10. In a rotary engine, the combination of a shaft, a rotating disk or wheel mounted thereon, a plurality of annular ribs attached to the side of the disk and disposed concentrically to the center of rotation thereof, a piston attached to each rib, annular cylinders having openings extending continuously around them in which openings the ribs are respectively fitted, the pistons operating respectively in the cylinders, and independently operative means for controlling the admission and exhaust of the motive agent to the several cylinders.

11. In a rotary engine, the combination of a shaft, a rotatable disk or wheel mounted thereon, an annular rib engaging the side of the disk and disposed concentrically to the axis of the center of rotation thereof, a piston engaging the outer edge of the rib, a tie-bolt extending through the piston-rib and disk to hold said parts rigidly connected, an annular cylinder having an opening extending continuously around the same in which opening the rib is loosely fitted, the piston working in the cylinder, means for mounting the cylinder, and means for controlling the admission and exhaust of the motive agent.

12. In a rotary engine, the combination of a shaft, a rotating disk or wheel mounted thereon, an annular rib attached to the side of the disk, a piston attached to the outer edge of the rib, an annular cylinder having an opening extending continuously around the same, in which opening the rib is loosely received, the piston operating in the cylinder, and means for controlling the movement of the motive agent in the cylinder, the said means including an abutment movable in and out of the cylinder, and the abutment having a packing-strip at its inner edge, said packing-strip being arranged to engage with the edge of the rib which runs in the cylinder.

13. In a rotary engine, the combination of a stationary shaft, a rotating disk or wheel mounted thereon, an annular rib attached to the side of the disk concentrically to the center of rotation thereof, a piston attached to the disk, an annular cylinder having an opening extending continuously around the same into which opening the rib is loosely received, the piston working within the cylinder, an abutment arranged to move in and out of the cylinder, an arm engaging the abutment to move the same, a rock-shaft on which the arm is mounted, the rock-shaft extending radially of the disk, a cam moving with the disk and adapted periodically to actuate the rock-shaft, the cylinder having admission and exhaust ports respectively at the sides of the abutment, a valve controlling the admission-port, a rocker engaged with the valve, a shaft carrying the rocker, said shaft extending radially of the disk, and a second cam moving with the disk and adapted to operate the last-named shaft.

14. In a rotary engine, the combination of a shaft, means for rigidly mounting the same, a rotating disk or wheel mounted on the shaft, a plurality of annular ribs attached to the side of the disk concentrically to the shaft, a plurality of annular cylinders having openings extending around the same in which openings the ribs are respectively fitted, a piston attached to each rib, the pistons operating in the cylinders, a spider attached to the shaft and sustaining the cylinders, an abutment arranged to move in and out of each cylinder, means for operating the abutment, the cylin-

der having admission and exhaust ports on opposite sides of the abutment, a valve-chest surrounding each admission-port, a motive-fluid connection leading to each valve-chest, a valve in each valve-chest coacting with the admission-port, and means for operating said valves.

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

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