(No Model.) 2 Sheets—Sheet 1.

T. HARDING.

ROTARY ENGINE.

No. 549,602. Patented Nov. 12, 1895.

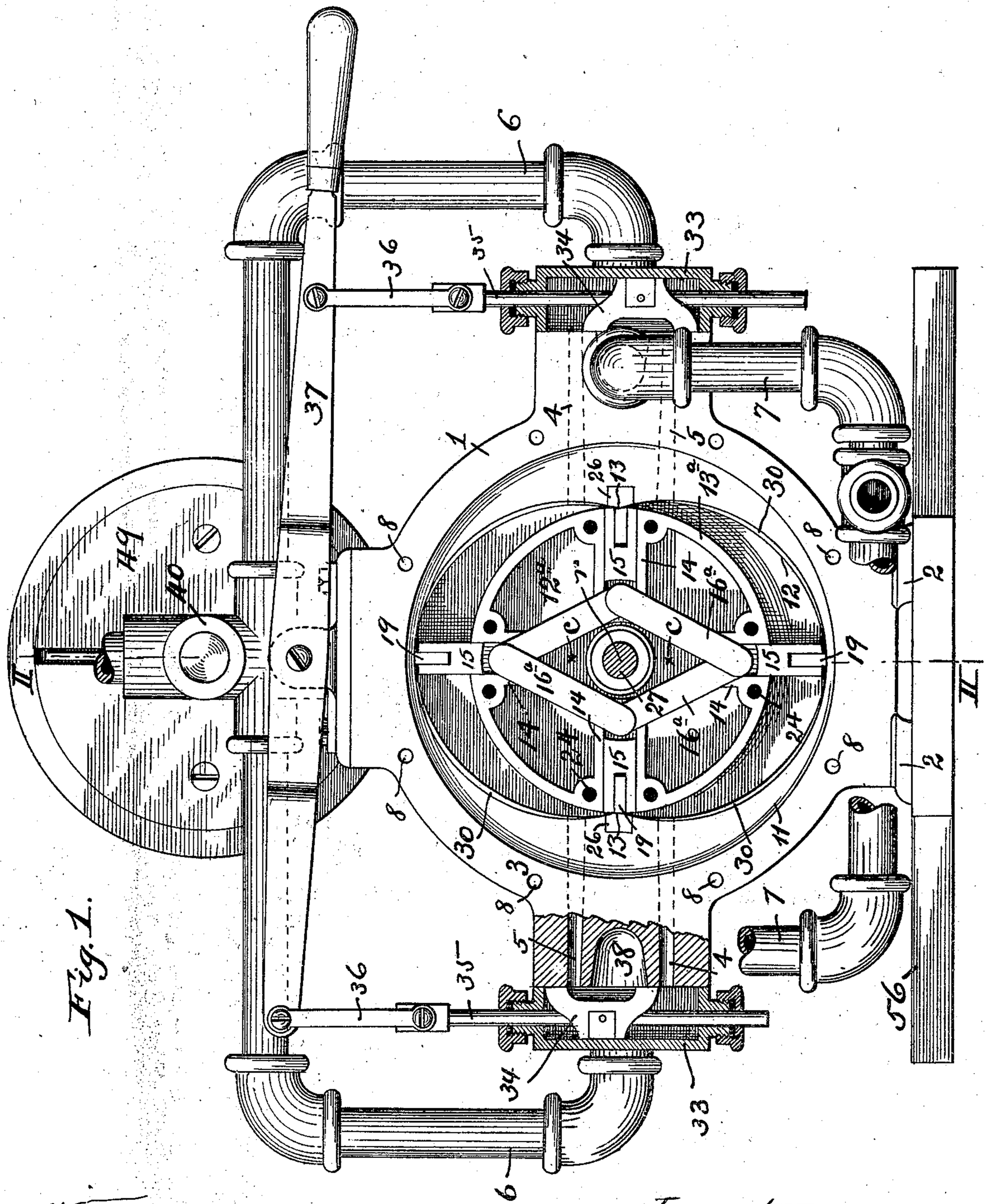

Fig. 1.

Witnesses:
H. Graham
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(No Model.) 2 Sheets—Sheet 2.

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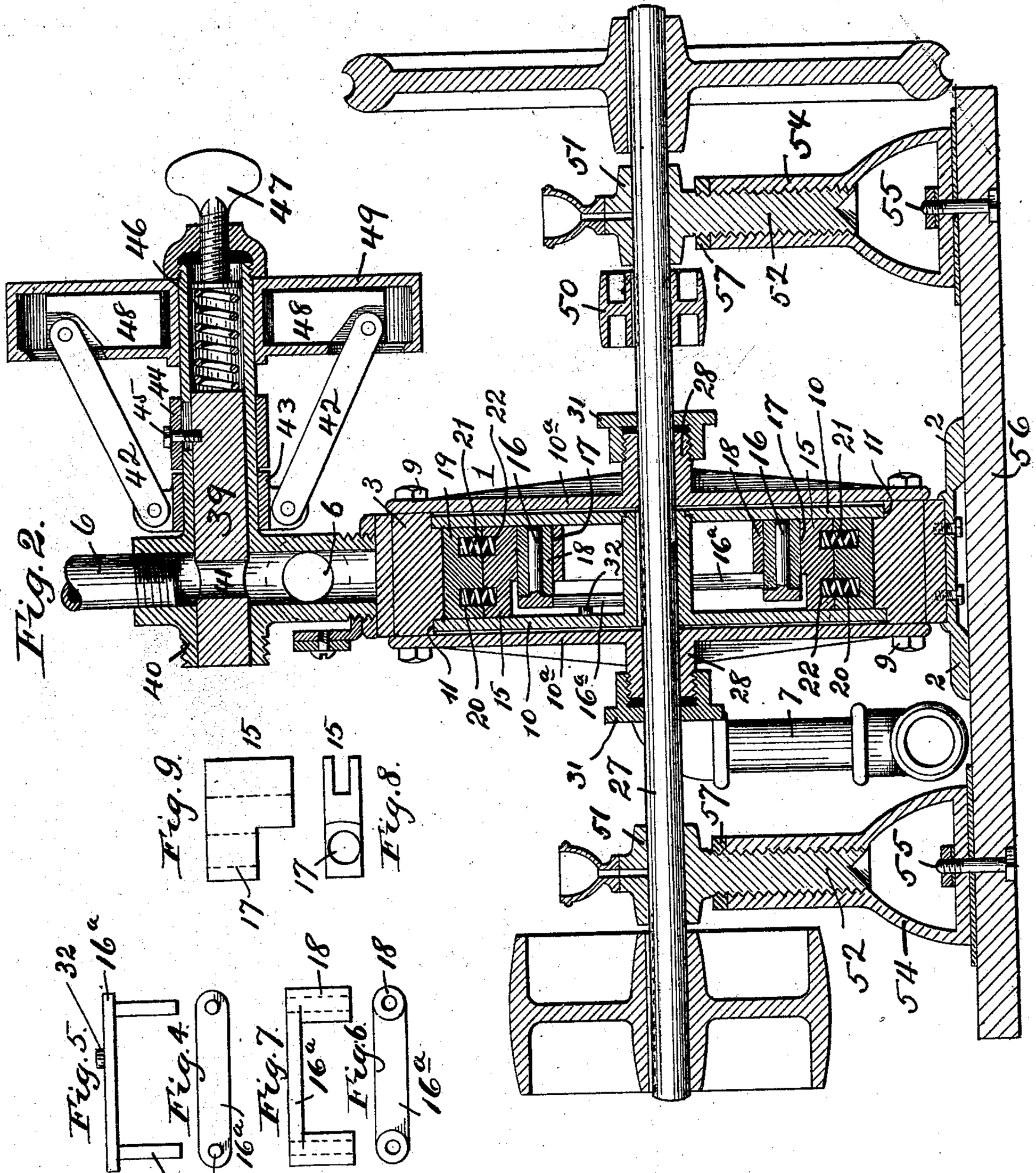

Fig. 2.

Fig. 9.

Fig. 8.

Fig. 5.

Fig. 4.

Fig. 7.

Fig. 6.

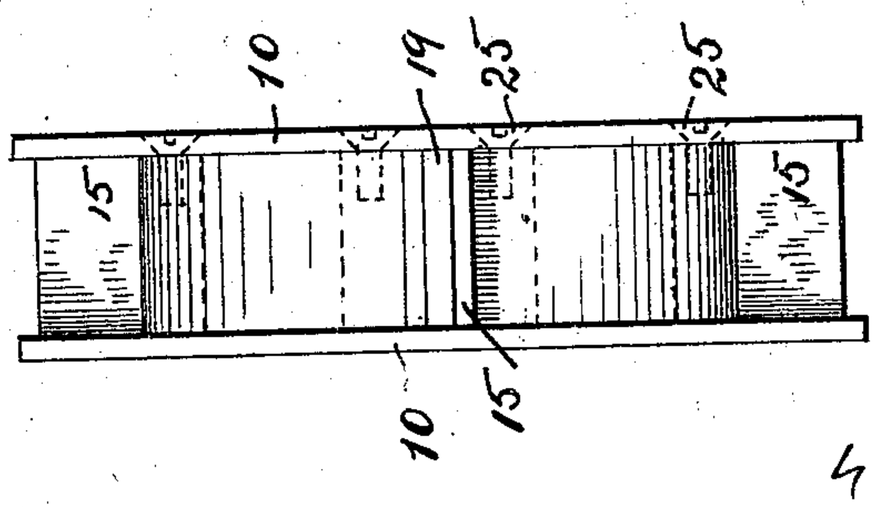

Fig. 3.

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UNITED STATES PATENT OFFICE.

THOMAS HARDING, OF SAN JOSÉ, CALIFORNIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 549,602, dated November 12, 1895.

Application filed March 2, 1894. Serial No. 502,102. (No model.)

To all whom it may concern:

Be it known that I, THOMAS HARDING, a citizen of the United States, residing at San José, in the county of Santa Clara and State of California, have invented certain new and useful Improvements in Rotary Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same

By the word "engine" as used in this specification I intend a mechanical contrivance employing the word in its broad sense. My improvement, therefore, is not to be confined to those devices which are termed specifically "rotary engines," in which a rotary motion of the piston is produced by the direct pressure of steam.

I wish it to be understood that my improvements hereinafter set forth may be availed of in the construction and use of not only rotary engines specifically, but also of water-motors, in which the rotary motion of the piston is produced by hydraulic pressure, of pumps in which the rotary movement of the piston produces a flow of water, and of water-meters in which the flow of water produces an indicating or measuring movement of the piston.

It is the object of my invention to much simplify this species of mechanical contrivance and to make it accurate and economical in use, my improvements relating more especially to the means for controlling the admission of steam or other propelling-fluid to the cylinder; to the means for automatically regulating the quantity of fluid supplied to the engine, and to the means for supporting the engine-shaft.

With such objects in view my invention consists in the parts and combinations thereof hereinafter particularly set forth and claimed.

In order to make my invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect without, however, limiting the improvement in its useful applications to the particular construction which for the sake of illustration I have delineated.

In said drawings, Figure 1 is a front or face view, partly in section, of a rotary engine embodying my improvements, one of the sides of the casing or cylinder being removed to give a full view of the interior and of the piston therein. Fig. 2 is a sectional view on line II II of Fig. 1. Fig. 3 is a side or edge view of the piston removed from the cylinder. Figs. 4, 5, 6, and 7 illustrate by side and edge views the links for connecting the sliding piston-plates. Figs. 8 and 9 illustrate by an edge and a face view one of the said plates.

Referring to the drawings, 1 indicates a casing or part which is stationary and serves the purpose of the cylinder of the engine. It is preferably provided with one or more base portions, flanges, or feet 2, by which it may be attached to a foundation or other stationary support. It is provided with a peripheral flange 3, through which enter into the interior of the cylinder the steam or water admission ports 4 4 and the exhaust-ports 5 5. A live-steam pipe 6 and an exhaust-steam pipe 7 are connected with these ports in any suitable manner, a convenient arrangement for which I have shown in Fig. 1.

The casing 1 is provided on one side of its head or on both sides, if neither of its heads is formed integral with the casing, with bolt-holes 8, into which enter bolts 9, by which the head or heads 10^a is or are secured in place. In the construction shown the casing is made with both of its heads 10^a separable. On each side of the casing is formed a rabbet or recess 11, bounded by a shoulder, which recess is of a diameter nearly as large as the interior dimension of the casing, which is concentric with the center of rotation of the piston hereinafter described, and which is of a greater diameter and surrounds the interior working opening of the casing or cylinder.

The boundary or working surface of the cylinder is indicated at 12. In a general shape it is oblong, being formed of two circular or substantially-circular portions, which are so situated relative to each other as that their boundaries intersect at the points 13, Fig. 1. The position of the centers of the two cylinder portions is indicated at *c o* in Fig. 1 and the center of rotation at *r*. I find the proportion between the distance apart of the points *c* and *r* to the distance between the points *c* and the working face of the cylinder, as shown in said Fig. 1, to be suitable for practical purposes. The desired result in determining

said proportion is that two or more sliding piston-plates when mutually controlled, as hereinafter described, shall follow without much variation the contour of the interior or working face of the cylinder.

The main body of the rotary part or piston is indicated at 12^a. Its particular shape is not of importance. I prefer to make it round and concentric with the center of rotation *r*. For the sake of lightness and in order to save metal the piston is preferably made hollow or partly hollow, bounded by a flange 13^a, which is of a width equal to the depth of the cavity of the cylinder 1. At two or more points in its periphery, preferably at four points, as illustrated, the flange 13^a is provided with or formed with guideways 14, in which fit radially-sliding piston-plates 15 of a width equal to that of the flange 13 and to the depth of the cavity of the cylinder. These piston-plates 15 are connected with each other, so as mutually to control each other by means of links 16^a, arranged so as to form a parallelogram, as seen in Fig. 1. The links, Figs. 4, 5, 6, and 7, run obliquely from one plate to the neighboring plate, which is at an angle to the first plate, and are connected with said plates by means of pins 16, formed, preferably, on two of the links and engaging sleeves 18, formed on the other two links, and said sleeves fit in bearings 17 in the piston-plates.

The foregoing being the construction and arrangement of the parts, it will be seen that as the live steam enters the port or ports 4 it will act upon the piston plate or plates 15 in advance of the said opening or openings and cause a rotation of said plates, together with the piston 12^a, around the center of rotation *r*. As this takes place, the plates 15, which are opposite to or which are approaching the points 13, will be forced inward by the contour or wall 12 of the cylinder and caused to so act upon the links which are pivoted to them as to force the other plate or plates 15, which are at or near the major axis of the oblong cylinder-cavity, outward into contact with or nearly into contact with the walls of the ends of said cavity. Inasmuch as the contours of the two portions of the cavity may not be of exactly the correct shape or have exactly the proper relation to each other, I prefer to provide the plates 15 with spring-actuated plunger-plates 19, which are provided with cavities 20, in which fit spiral springs 21. These springs rest upon the bottom of recesses 22 in the plates 15 and tend to constantly press said plunger-plates outward into steam-tight contact with the walls of the cylinder. As the piston revolves, there will be a slight inward and outward play of these plunger-plates, in which movement they will be guided by the walls of the said recesses.

At the points 13 on the minor axis of the oblong cavity of the cylinder I prefer to fit into the walls of the latter, in suitably-formed recesses, bronze or other suitable metal pieces 26, which are adapted to be adjusted outward by suitable packings, so that a steam-tight joint will always be maintained on the minor axis of the cylinder where there will be considerable wear.

25 indicates bolts, which pass through the head-plate 10 of the piston and are adapted to engage with screw-threaded holes 24 in the body of the latter or in the opposite head-plate. The head-plates 10 fit closely against the sides of the piston-plates 15 and rotate in the recesses 11, already described, which are formed in the sides or ends of the cylinder-casing.

27 is a shaft concentric with the center of rotation *r*, upon which shaft are mounted the rotary piston and the two piston-heads 10. The heads 10^a are preferably provided with central bosses or bearings 28 for the shaft.

When the device is used as a rotary engine specifically, power may be derived from a suitable wheel or pulley mounted upon the central shaft. When the device is employed as a pump, rotary movement may be imparted to the piston by means of a belt or other power device connected with the said pulley and running from any suitable prime motor or engine.

The inclosing side or end plates of the casing are provided with suitable stuffing-boxes 31, through which the ends of the central shaft pass out by steam-tight joints.

It will be observed that the live-steam ports are so situated that steam is admitted simultaneously at both sides of the piston-head in both portions of the cylinder-cavity, so as to effect a complete balance of pressure upon the piston. These ports may be readily arranged so that there will be no dead-center upon which the piston can stop.

In engines of large diameter it will be preferable or necessary to fit the interior walls of the cylinder-cavity with pieces 30, substantially in the shape of lunes, which will modify the contour of the cylinder-cavity from that of a true circle, or portion of a circle, and enable the radially-movable plates 15 to travel more closely to the interior walls or surfaces with which they form a steam-tight joint, thus requiring less movement of the plunger-plates in the piston-plates.

32 are bosses on the backs of the outer of the links 16^a, adapted to bear on the inner face of the plate 10, whereby all four links are kept in place.

While the live steam and exhaust pipes 6 and 7 may be connected permanently with the ports 4 and 5, respectively, and the engine run always in the same direction, unless live steam be turned into the pipe 7 and pipe 6 used as an exhaust, I prefer the arrangement shown in the drawings, which enables the functions of the ports 4 and 5 to be interchanged and the direction of rotation to be readily reversed. To this end the steam-ports are provided with a steam-chest 33, one at each side of the engine, into which the live-

steam pipe 6 delivers, and in said chests are fitted slide-valves 34, adapted to place at the will of the engineer either the ports 4 or the ports 5 in communication with the chests, so as to receive steam. These valves are mounted on rods 35, which pass through stuffing boxes in the heads of the chests 33 and are pivotally connected with links 36. The latter are joined to opposite arms of a lever 37, by the oscillation of which the valves 34 will be oppositely reciprocated to wholly or partly shut off steam or to admit steam at both sides of the engine, either to the back or to the front faces of the piston-plates, giving either a forward or backward rotation to the engine, as may be desired.

The casing 1 is formed with exhaust-cavities 38, with which the pipe 7 communicates, and which are caused to receive exhaust-steam from either the ports 4 or the ports 5, according to the positions of the slide-valves.

When the machine is used as a high-speed motor, the supply of steam to the pipe 6 is governed in a very simple and effective manner.

39 is a slide-valve in a bearing 40, running transversely of the pipe at a point above where it branches to the two steam-chests. This valve has a port 41, which may be caused to more or less fully register with the pipe-opening by moving the valve 39. Such movement is automatically effected by links 42, connected with a rotary collar 43 on the exterior of the bearing 40, which collar bears against a sliding collar or sleeve 44, connected through a slot in the bearing 40 by a bolt 45 with the valve. A spring 46 tends to force the valve 39 to its full-port position and the tension of the spring, on which in a measure will depend the speed of the machine, may be regulated by a screw 47, mounted in the end of the bearing 40, and adapted to be screwed in against the outer end of the spring. The links 42 connect with weights 48, adapted to slide radially to the axis of the bearing 40 in suitable guideways in a combined governor-casing and belt-pulley 49. The said bearing 40 being parallel with the shaft 27, the pulley 49 is belted directly to a driving-pulley 50 on said shaft. When the speed of the engine is too great, the weights 48 will be forced farther outward, overcoming the tension of the spring 46 and causing the links 42 to draw on the valve 39 and diminish the steam-passage through the latter, thus forming a very simple high-speed governor especially adapted for a rotary engine.

The bearings 51 for the shaft 27 are formed with screw-threaded shanks 52, which may be screwed up or down to bring the bearings to the desired height in female screw-threaded stands 54, bolted at 55 to a base-plate 56, to which latter are secured the flanges 2 of the engine-casing. When adjusted, the shanks 52 are clamped by jam-nuts 57.

I claim—

1. In a rotary engine, the combination with the cylinder having ports, and the conduit exterior to the cylinder and connecting said ports, of a rotary piston head therein, piston plates carried by such head, slide valves normally stationary on opposite sides of the cylinder controlling said ports, a transverse pivoted lever 37, and links connecting the valves with the said lever for reversing the engine, substantially as set forth.

2. The combination with the engine casing having ports 4 and 5, the rotary piston provided with the piston plates, and links connecting the contiguous plates, of the slide valves normally stationary, and adapted to cooperate with the ports and with exhaust passages for reversing the engine, a pivoted lever 37, and pivoted connections uniting the slide valves with said lever, substantially as set forth.

3. In a governor for a rotary engine, the combination of the bearing 40, the sliding valve 39 therein, the sliding collar 44 on said bearing and connected with the valve 39, the rotary and sliding collar 43 adapted to engage said collar 44, links 42 connecting the collar 43 and radially sliding weights 48, and a rotary casing mounted on the bearing 40 and inclosing said weights, substantially as set forth.

4. In a rotary engine, the combination of the cylinder and steam supply pipe therefor having a horizontal transverse bearing 40, valve 39, a spring 46, rotary collar 43 mounted upon the exterior of said bearing, links 42 connecting said collar with sliding weights 48, and casing 49 entirely inclosing said weights, substantially as set forth.

5. In a rotary engine the combination with the casing having ports, a conduit connecting said ports, and slide valves controlling said ports, of a rotary piston head, slides carried by said head, links connecting said slides, and flanges which inclose said slides and links and rotate with the piston head, one of said slides having a sleeve or hub keyed to the engine shaft, and the other flange being mounted on the end of said hub, substantially as set forth.

In testimony whereof I affix my signature in the presence of two witnesses.

THOMAS HARDING.

Witnesses:

J. FAIRLEY WIELAND,

J. R. KERSHNER.