No. 622,952.

Patented Apr. 11, 1899.

G. W. HUNTER.

ROTARY ENGINE.

(Application filed June 23, 1898.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

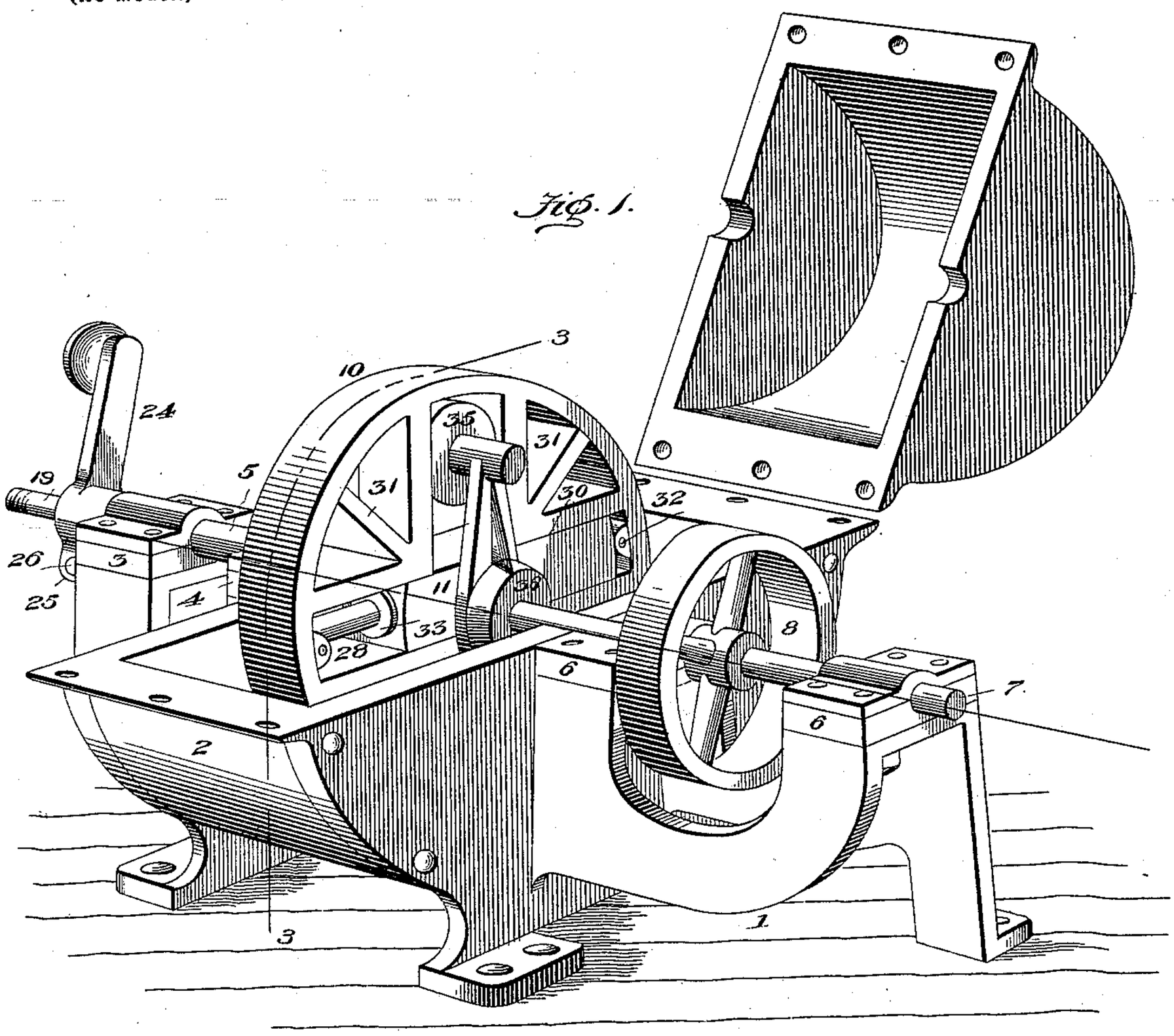
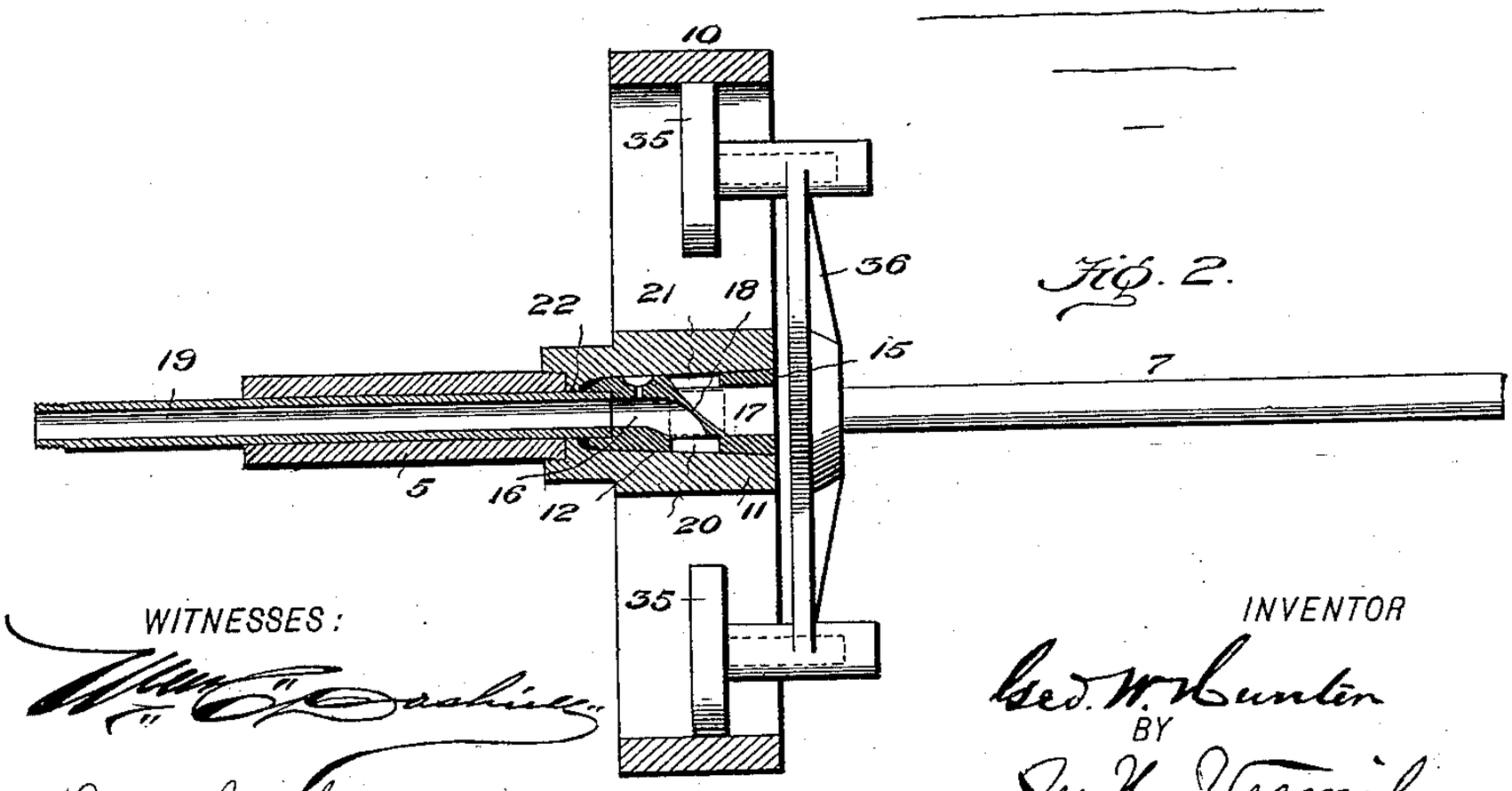


Fig. 2.



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2 Sheets—Sheet 2.

Fig. 4.

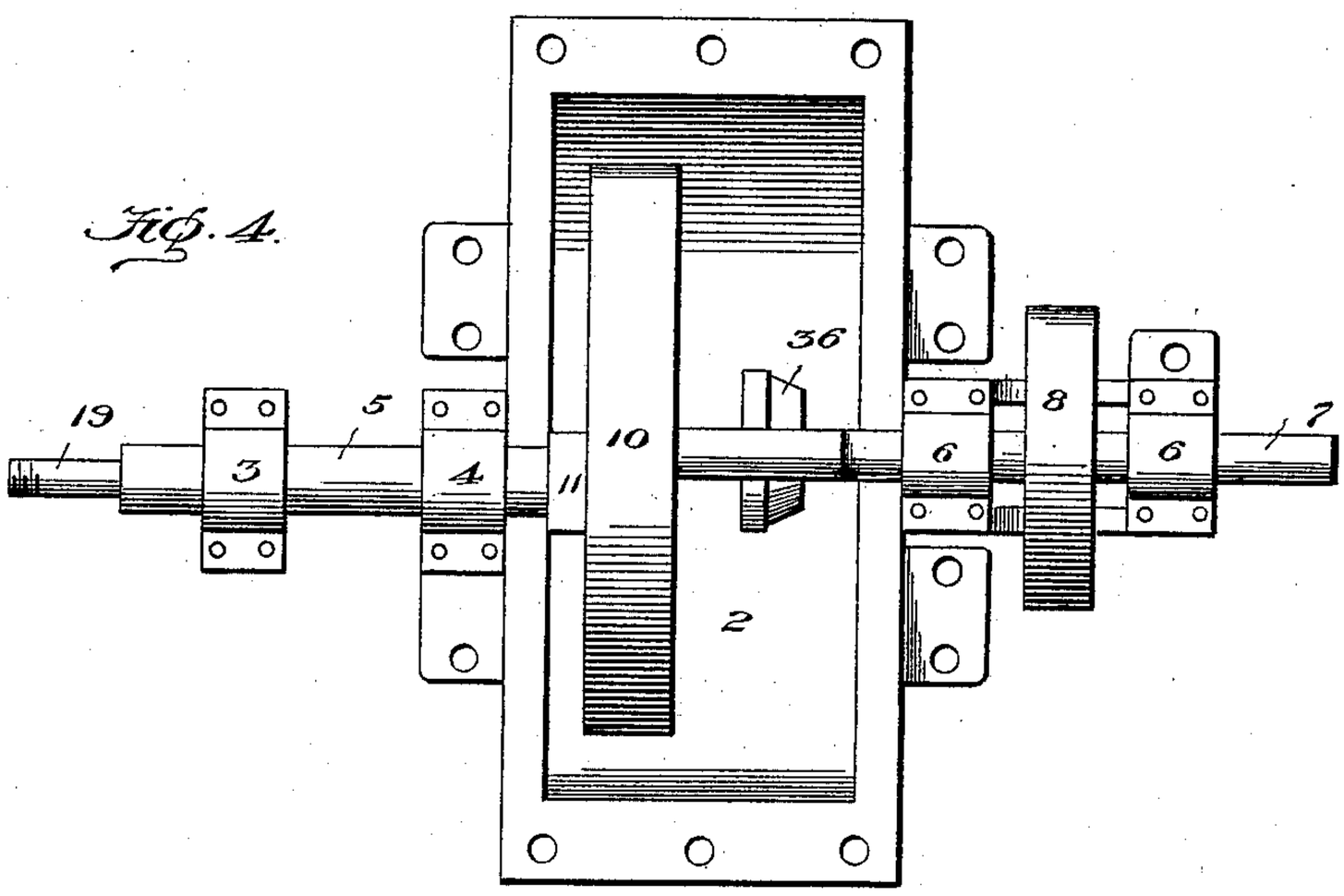


Fig. 5.

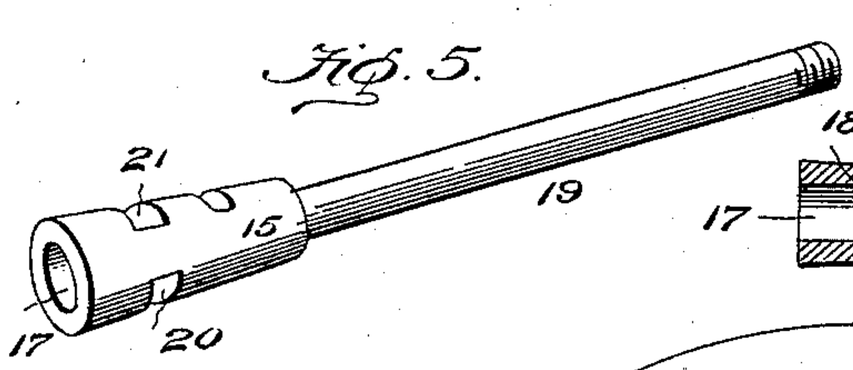


Fig. 6.

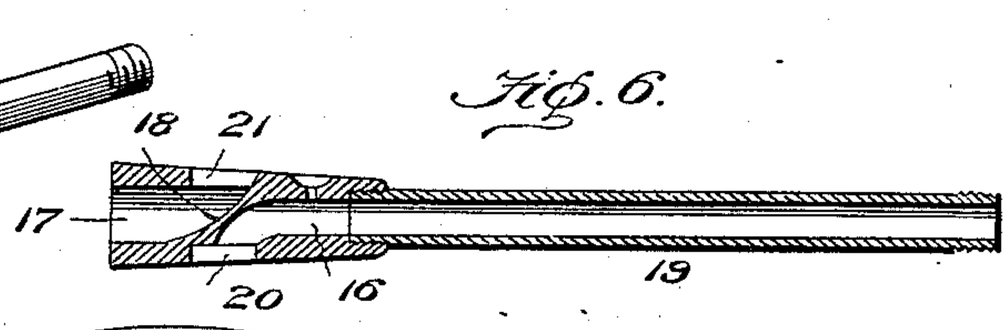
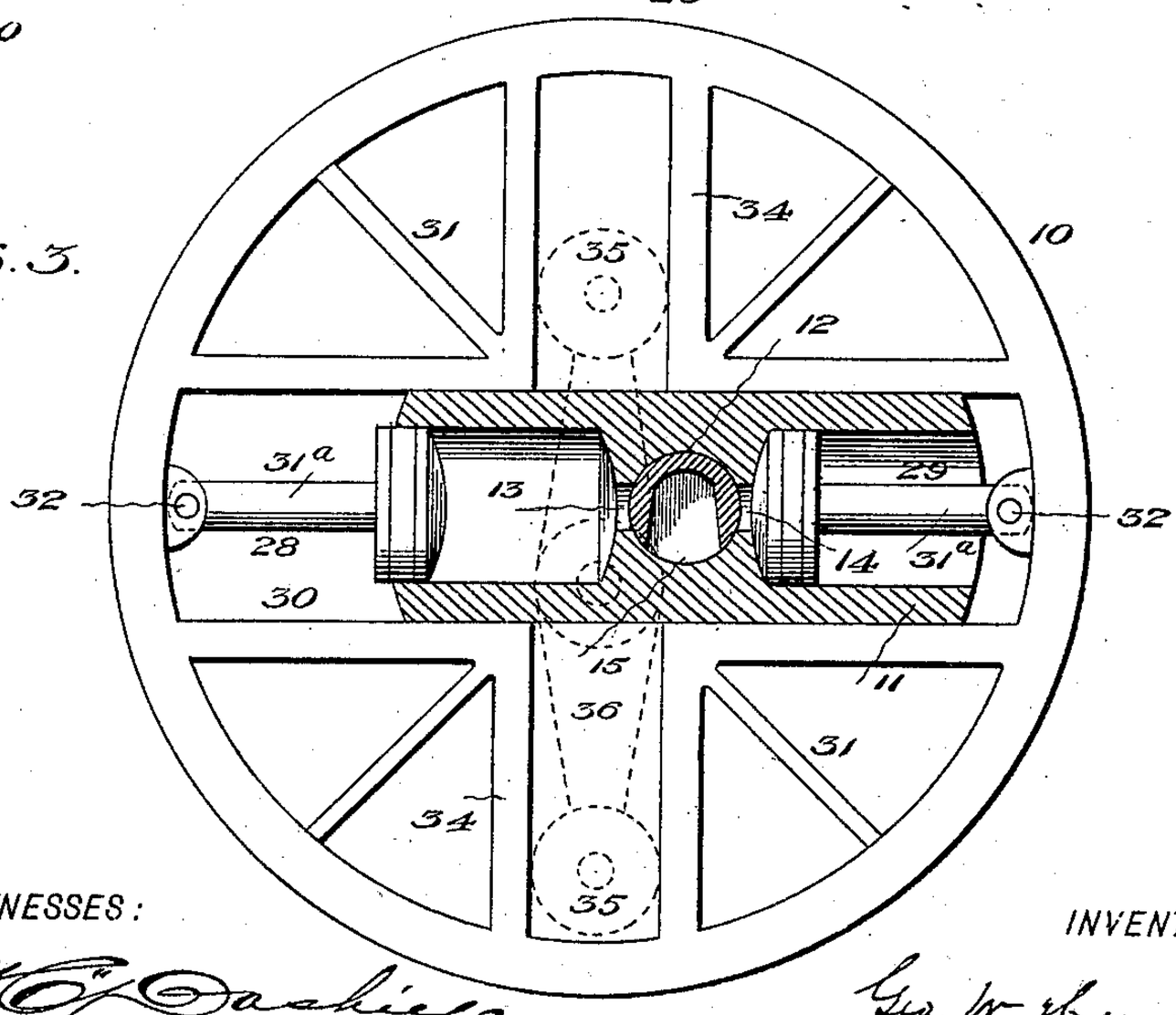


Fig. 3.



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UNITED STATES PATENT OFFICE.

GEORGE W. HUNTER, OF CLIFTON STATION, VIRGINIA, ASSIGNOR TO HIMSELF, AND HORACE S. CUMMINGS, OF WASHINGTON, DISTRICT OF COLUMBIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 622,952, dated April 11, 1899.

Application filed June 23, 1898. Serial No. 684,245. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. HUNTER, a citizen of the United States, and a resident of Clifton Station, county of Fairfax, State of Virginia, have invented a new and useful Improvement in Rotary Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification.

My invention relates to improvements in rotary engines in which the several elements are so constructed as to permit of lubrication of the working parts which are exposed to friction by the action of steam as it is fed to and exhausted from the cylinder.

A further object of the invention is to simplify the construction and promote the efficiency and durability of the machine.

A further object of the invention is to provide an improved valve mechanism which may be easily and quickly adjusted to compensate for wear which may take place on the working parts.

A further object of the invention is to construct the rotary cylinder and fly-wheel of the engine in a single structure, thereby simplifying the structure of the engine.

With these ends in view my invention, briefly stated, consists in the combination, with a valve mechanism of peculiar form, to be described specifically hereinafter, of a rotary double cylinder mounted on a rotary shaft and having a rotary central conical valve with ports which open into the piston-chambers, a fly-wheel forming the support for the pistons and having a guideway for the reception of the cylinder and other guideways for the rollers of a cross-head, an engine-shaft carrying the cross-head, with rollers or guides adapted to certain of the ways in the fly-wheel, and mechanical devices connecting said fly-wheel with the cylinder-pistons and with the engine-shaft; and the invention further consists in the novel combination of elements and in the construction and arrangements of parts, which will be hereinafter fully described and claimed.

To enable others to understand the invention, I have illustrated the preferred embodiment thereof in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a perspective view of a rotary engine constructed in accordance with my invention. Fig. 2 is a vertical longitudinal sectional elevation on a plane through the rotary cylinder-shaft and the engine-shaft. Fig. 3 is a sectional elevation on a plane at right angles to Fig. 2 and on the dotted line 3 3 of Fig. 1. Fig. 4 is a plan view of the engine with the casing opened to show the relation of the shafts. Fig. 5 is a detail perspective of the steam-pipe and valve-seat, and Fig. 6 is a longitudinal section through the valve-seat shown by Fig. 5.

Like numerals of reference denote like and corresponding parts in each of the several figures of the drawings.

1 designates the bed-plate, on which is erected the box or casing 2 for housing the operative parts of the engine and for retaining to a certain extent the exhaust-steam for lubricating the surfaces of the working parts which are exposed to friction and wear. A pillow-block or standard 3 is erected at the end of the base, and between this pillow-block and one side of the casing is the bearing 4, which supports the rotary tubular shaft 5. From the other side of the box or casing extends an arm which carries the alined journal-bearings 6, in which is mounted the engine-shaft 7, the latter carrying a belt-pulley 8 or other form of power-transmitting appliance.

One of the important features of my engine consists in arranging the engine-shaft in a position on one side of the cylinder-shaft 5 so that the axes of the two shafts 5 7 are out of alinement with each other and the fly-wheel is arranged to have its imaginary axis in a plane about midway between the axial lines of the two shafts to occupy an eccentric relation thereto. The hollow or tubular shaft 5 carries a double open-ended cylinder 11, and these elements (the shaft and the double cylinder) are joined axially together for rotation simultaneously. Through the center of the double cylinder extends the rotary sleeve-like valve-seat 12, which may be made

an integral part of the cylinder, or it may be in a separate piece of steel united rigidly to the center of the cylinder between the piston-chambers thereof. In one embodiment of the invention, such as represented by the drawings, I prefer to make the double cylinder with an integral partition at the center thereof, and in the metal forming this partition is bored or drilled a conical passage or hole, in the wall of which are produced diametrically opposite openings forming the ports for the admission of the motive fluid to or the exhaust of said motive fluid from the piston-chambers of said double cylinder. The ports for the sleeve-like valve-seat are indicated at 13 14 in the drawings, and this port 13 is made somewhat longer than the port 14 in order to provide for the free escape of the live steam or air under pressure and to give the necessary clearance and quick action to the parts.

15 designates the valve, which is made in a single piece of metal and of tapering form, and said valve is designed and proportioned to fit snugly in the valve-seat 12. The conical or tapered valve is peculiarly formed for the admission and exhaust of steam in that the valve takes the steam at its axis and supplies it radially to the cylinder-ports and exhausts the steam in the reverse way by receiving the steam from the cylinders radially and discharging it axially. There are two longitudinal bores or axial passages provided in the conical valve, and of these longitudinal passages the one indicated by the numeral 16 constitutes the live-steam passage, while the other axial passage 17 is the exhaust-passage. A bridge-wall or abutment 18 separates these passages, so that there shall be absolutely no communication between them, and this bridge-wall is made as an integral part of the valve. The live-steam passage 16 extends to and opens through the smaller end of the valve, at which point the valve is coupled to a live-steam pipe 19, while the other end of the passage 16 terminates in a feed or supply port 20, which lies adjacent to the abutment 18 and opens through the face of the valve at a point intermediate of the the length thereof. The other or exhaust-steam passage 17 extends from the abutment 18 to and through the large open end of the valve, and the passage 17 opens through the valve adjacent to the abutment 18 to form the exhaust-port 21. The live and exhaust ports 20 21 are disposed on opposite sides of the abutment 18, and they open through opposite faces of the valve, as clearly shown by the drawings, and the walls of the abutment 18 are inclined, so as to facilitate the egress of the motive fluid from and its ingress to the passages of the valve.

The supply-pipe 19 is joined to the smaller end of the conical valve by a threaded joint or coupling, as shown, which allows the valve to be adjusted within the conical seat of the double cylinder for the purpose of taking up the wear that may be occasioned by the friction of the working parts. This valve is fitted to its seat in the double cylinder so as to have its smaller end face toward a shoulder 22 in the valve-seat 12, thus leaving a small space between the valve and the shoulder, and this space provides for the adjustment of the valve in the seat for the purpose described.

The feed-pipe 19 occupies, with the valve, a stationary position when the shaft 5 and the double cylinder are rotated by the action of the parts; but this pipe 19 extends through the rotary shaft 5 to have one end thereof protrude from the shaft and the bearing thereof, whereby the shaft 5 is free to rotate within its bearing and around the pipe that supplies the live steam to the double cylinder. To this protruding end of the pipe 19 is coupled a suitable steam pipe or hose (not shown) for the purpose of supplying the steam, compressed air, or other motive fluid by which the engine may be driven. The motive fluid is free to pass through the pipe 19 into the passage 16 and then through the port 20 and the port 13 into one of the piston-chambers of the double cylinder, and at the same time the exhaust-steam from the other piston-chamber of the double cylinder passes through the port 14 into the port 21, thence to the exhaust-passage 17, and emerges from the open large end of the valve into the casing or housing of the engine.

The feed-pipe 19 and the valve 15 normally remain at rest when the engine is in service; but the pipe and valve are not fixed immovably in place by positive locking devices, because the pipe and valve are designed to be adjusted axially for the purpose of cutting off the steam-supply and of reversing the engine. To this end the pipe 19 is provided with a suitable handle 24, which has its inner end split or divided, as at 25, to form jaws adapted to embrace the protruding end of the pipe 19, said jaws being drawn firmly upon the pipe by a clamping-screw 26 or its equivalent, whereby the pipe and valve may be rotated to adjust the valve for its ports 20 21 to occupy a reverse relation to the ports 13 14 in the cylinder and reverse the order of admission and exhaustion of the motive fluid to and from the piston-chambers of the double cylinder. I may also provide the pipe 19 with a locking device to hold the valve in its adjusted position for the purpose of cutting off the steam partially or wholly; but this locking device for the valve may be of any suitable construction.

The cylinder is open at both ends, and in it are fitted the pistons 28 29, the rods of which are extended to the fly-wheel 10. The piston-heads are beveled backward from the central portions thereof toward the edges, and the central partition or sleeve, which forms the valve-seat of the cylinder, has its faces opposed to the piston-heads formed with dished surfaces, the contour of which is the reverse

of the faces of the piston-heads. This construction of the cylinder and the piston-heads prevents the loss and waste of steam to a very large extent, because the partition or sleeve-like valve-seat is made quite thin by the peculiar form of the face and by the boring of the conical hole to produce the valve-seat, whereby the partition or bushing produces ports 13 14, with a minimum depth. The fluid-passage in the valve-seat and the piston-chambers of the cylinder thus communicate with each other through exceedingly short ports 13 14, and the loss and waste of steam by leading it along the length of and across the cylinder is thereby prevented.

The fly-wheel 10 is peculiarly constructed to accommodate the cylinder and the guide devices which operatively connect a cross-head with said fly-wheel. A guideway 30 is arranged to extend transversely across the fly-wheel, and said guideway is formed by grooved bridges or bars, between which is arranged the elongated double cylinder 11. Along the sides of this cylinder are provided the ribs 31, which are accurately fitted in the grooved bars forming the guideway 30 of the fly-wheel, whereby the cylinder and the fly-wheel are connected together for one part to move or play on the other in the rotary motion of the engine, while at the same time the cylinder and fly-wheel rotate together. The piston-rods 31^a are attached to the fly-wheel within its periphery by the bolts 32, and these piston-rods are properly connected with the piston-heads 33, which are fitted in the chambers of the double cylinder. The piston-rods are attached to the fly-wheel at diametrically opposite points, and they are actuated to move in opposite directions simultaneously, thereby utilizing the expansive energy of the motive fluid in shifting the position of the fly-wheel in relation to the rotary double cylinder and through the cross-head and its connections with the rotatable shiftable fly-wheel insuring the rotation of the engine-shaft. On the face of the fly-wheel adjacent to the cross-head and arranged at right angles to the cylinder-guideway are provided the bearing-flanges 34, which are cast as an integral part of the fly-wheel and which constitute the ways or tracks for the antifriction-rolls 35, which are journaled idly on the pins or arbors of a cross-head 36, which is attached rigidly in a suitable way to the inner end of the engine-shaft 7, whereby the engine-shaft is operatively connected to the fly-wheel to be driven thereby, and at the same time the necessary play is provided for the shiftable fly-wheel under the action of the pistons as the latter are acted on by the motive fluid admitted alternately to the chambers of the double cylinder. I do not, however, limit myself to the particular connections described between the engine-shaft and the fly-wheel, which is arranged in eccentric relation to the cylinder-shaft and the engine-shaft, because I am aware that the ordinary engine-slides may be used in lieu of the antifriction-rolls and the tracks or guides therefor.

The operative elements of the engine are housed within the casing 2, and a cover 38 is provided for the casing, so that all the operating parts of the engine may be confined within the casing, the latter serving also to confine the exhaust-steam to insure the lubrication of the working parts by the action thereon of the exhaust-steam. This feature of lubricating the working parts of the engine by the steam which is supplied to or exhausted from the engine is one feature of my invention, and I attach importance to the construction and arrangement of parts by which this end is attained. Suitable oil-cups are provided, however, at the bearings for the shafts 5 7, as will be appreciated by the skilled constructor. The casing or housing has an exit-port at or near its bottom for the escape of the water of condensation, and said casing also has a small exhaust-port for the slow escape of the motive fluid.

As the motive fluid is supplied under pressure through the tubular shaft and the hollow valve it passes through the valve-port 13 and the valve-seat port 20 to one of the piston-chambers in the double cylinder and acts against one of the pistons therein to force the piston in a radial direction. As the piston is connected with the fly-wheel and the latter is in eccentric relation to the cylinder, the fly-wheel is given a rotary impulse, thus setting in motion the cylinder, the cross-head, and the engine-shaft. As the valve-seat within the cylinder makes a half-turn the port 13 of the valve-seat alines with the port 21 of the valve to admit the fluid under pressure to the other piston-chamber, while at the same time the port 20 alines with the port 14 to exhaust the fluid from the first piston-chamber through the exhaust-passage of the valve, and thus the live motive fluid is supplied to and exhausted from opposite piston-chambers of the double cylinder alternately. The rotation of the fly-wheel carries with it the cross-head and the engine-shaft and also the double cylinder; but as the cross-head and the double cylinder are slidably connected with the fly-wheel the latter compensates or adjusts itself automatically in the rotation of the parts.

My engine consists of comparatively few parts, each simple in construction. The double cylinder may be cast in a single piece, as may also the fly-wheel. The pistons may each be cast in a single piece, and they are of such simple nature that finishing thereof is reduced to a minimum. The valve is also of simple construction, and all the parts of the engine require comparatively little machine-work to finish and adapt them for service.

In my engine the loss of steam is reduced to a minimum by having the ports located to establish direct connection of the valve to

the piston-chambers and the latter receive double lubrication—*i. e.*, from the live steam as well as from the exhaust-steam. The valve may readily be adjusted to compensate for wear, and it is capable of easy adjustment and reversal. The rotary cylinder is supported by a shaft which rotates therewith, insuring accuracy and ease of operation.

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

1. In a rotary engine, the combination of a revoluble multiple cylinder, an engine-shaft in eccentric relation to the axis of rotation of said cylinder, a fly-wheel slidably connected to and revoluble with the engine-shaft, and pistons connected operatively with the fly-wheel, substantially as described.

2. In a rotary engine, the combination of a revoluble multiple cylinder, a fly-wheel slidably related to said cylinder and revoluble therewith, pistons in said cylinder-chambers and connected actively with the fly-wheel, and an engine-shaft in eccentric relation to the axis of rotation of the cylinder and slidably connected with the fly-wheel to be rotated thereby, substantially as described.

3. In a rotary engine, the combination of a hollow cylinder-shaft carrying a revoluble multiple cylinder, means for supplying motive fluid to and exhausting the same from the piston-chambers of said cylinder, an engine-shaft in eccentric relation to the axis of rotation of said cylinder, pistons in the chambers of said multiple cylinder, and a shiftable fly-wheel operatively connected with the engine-shaft and with the cylinder to rotate therewith and also connected with the cylinder-pistons to be shiftable therewith, substantially as described.

4. The combination of a rotary cylinder having a valve-seat, a hollow valve fitted to said seat and provided with feed and exhaust channels, a fly-wheel in eccentric relation to the axial center of rotation of the cylinder, pistons in said cylinder, and connected with the fly-wheel, an engine-shaft out of alinement with the axis of rotation of the cylinder and with the imaginary axis of the fly-wheel, and a cross-head on the engine-shaft which is slidably connected with said fly-wheel, substantially as described.

5. In a rotary engine, the combination of a revoluble cylinder provided with a sleeve-like valve-seat, having ports which communicate with the piston-chambers of said cylinder, the non-revoluble hollow valve fitted accurately to the valve-seat and having the live and exhaust passages which terminate in ports isolated one from the other by an intermediate abutment, pistons in the chambers of said cylinder, an engine-shaft, and operative connections between the pistons and said engine-shaft to rotate the latter, substantially as described.

6. In a rotary engine, the combination of a hollow cylinder-shaft, a multiple cylinder fast with said shaft and having a sleeve-like valve-seat, an axially-adjustable non-revoluble valve housed within said hollow shaft and the valve-seat and provided with separate live and exhaust passages, means connected with said valve to reverse the relation of its ports to the piston-chambers of the cylinder, an engine-shaft, pistons in the chambers of said cylinder, and means actuated by the pistons and connected with the engine-shaft to rotate the latter, substantially as described.

7. In a rotary engine, the combination of a revoluble multiple-chambered cylinder, an engine-shaft in eccentric relation to the axis of rotation of the cylinder, a shiftable fly-wheel revoluble with the cylinder and connected operatively with the cylinder-pistons to be shiftable therewith, and a cross-head carried by the engine-shaft and slidably connected with the fly-wheel to be rotated thereby substantially as described.

8. In a rotary engine, a shiftable and rotary fly-wheel provided with transverse guideway for a cylinder, and with other guideways at right angles to the cylinder-guides, in combination with a rotary cylinder fitted to the first-named set of guideways, an engine-shaft, a cross-head having connections which are fitted in the guideways of the fly-wheel, and a valve mechanism for supplying motive fluid to, and exhausting it from, the double cylinder, substantially as described.

9. In a rotary engine, the combination with a double cylinder provided with a tapered valve-seat, of a conical valve fitted to said seat and having the axial feed and exhaust channels separated by an intervening abutment and with their ports disposed on opposite sides of the abutment and opening through opposite faces of the valve, pistons fitted in the chambers of the double cylinder, an engine-shaft, and operative connections between the pistons and said shaft, substantially as described.

10. In a rotary engine a multiple-chambered cylinder having the tapered sleeve-like valve-seat and with the dished inner heads of the piston-chambers provided with the shallow ports, combined with a tapered valve fitted in said seat of the revoluble cylinder, pistons in the cylinder-chambers, an engine-shaft, and means connecting the pistons with said shaft, substantially as described.

11. In a rotary engine, the combination of an inclosing casing, a hollow shaft supported in casing, a multiple-chambered cylinder fast with said shaft and having a valve-seat, a valve contained in said hollow shaft and having independent live and exhaust channels, the exhaust-channel of the valve discharging into the casing, means for supplying live motive fluid to the valve, an engine-shaft, pistons in the chambers of the cylinder, and a fly-

wheel slidably related to and connected with the cylinder and the engine-shaft to rotate therewith; the working elements of the engine being contained in said casing and having the surfaces thereof exposed to the exhausted fluid discharged by the valve to said casing, substantially as described.

In testimony whereof I have set my hand, this 23d day of June, A. D. 1898, in the presence of two attesting witnesses.

GEORGE W. HUNTER.

Witnesses:

DORA L. STONE,

LOTTIE A. WATERS.