No. 816,285. PATENTED MAR. 27, 1906.

I. ABBOTT.

ROTARY ENGINE.

APPLICATION FILED AUG. 4, 1904.

3 SHEETS—SHEET 1.

Fig. 2.

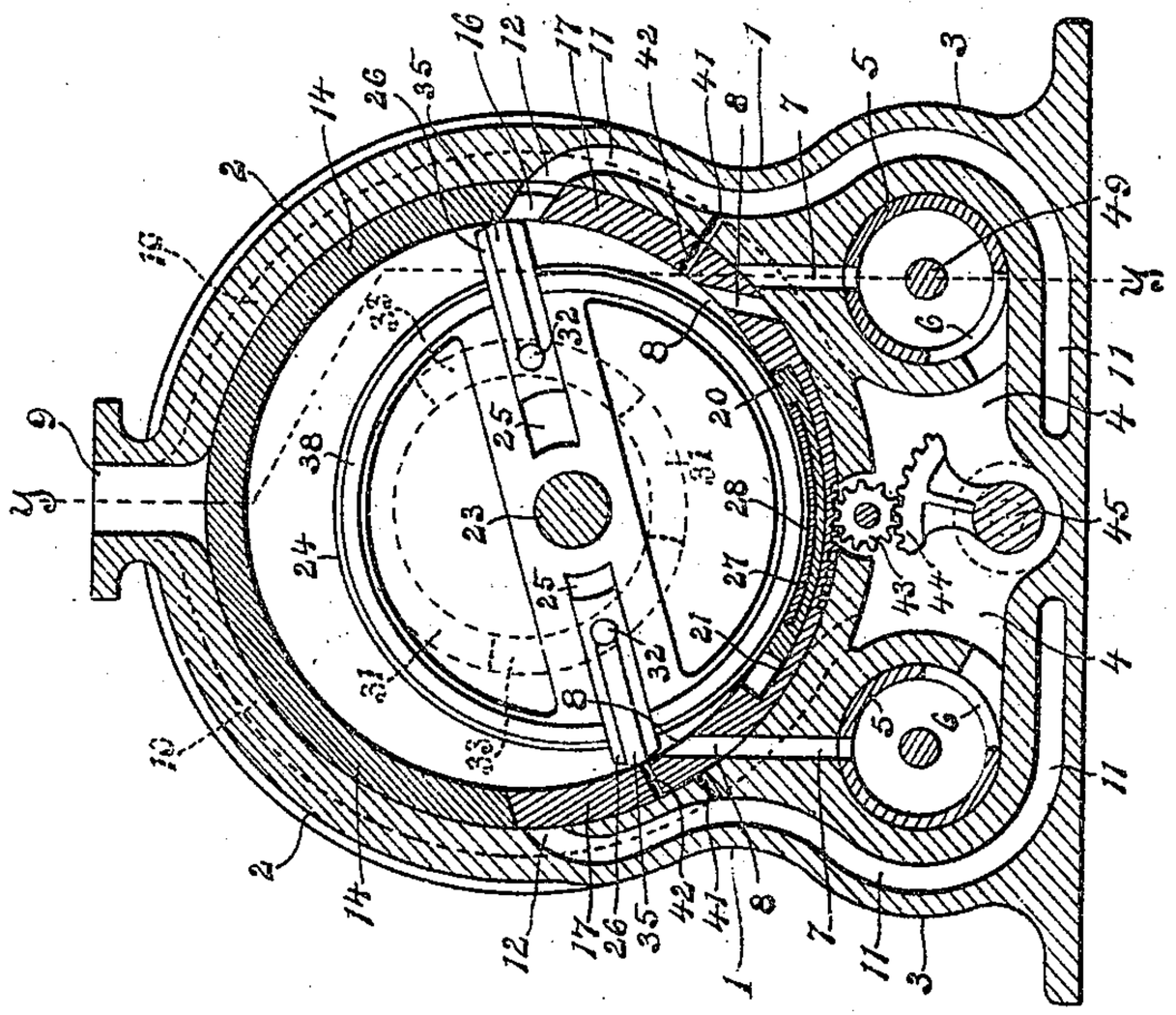
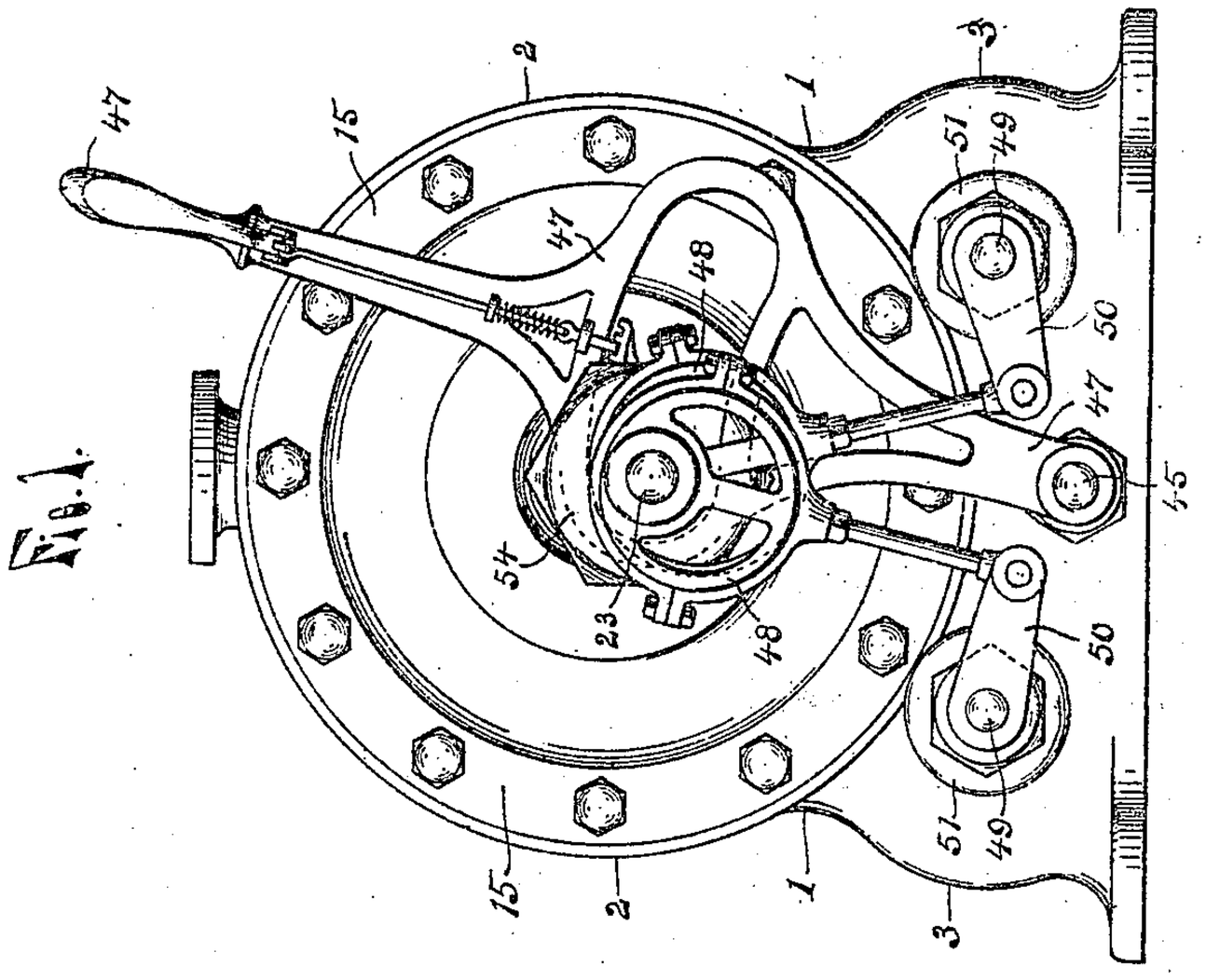


Fig. 1.



WITNESSES.

Lewis E. Flanders

Oliver C. Barthel

INVENTOR.

Ira Abbott

By Barthel & Barthel

Attorneys.

No. 816,285. PATENTED MAR. 27, 1906.

I. ABBOTT.

ROTARY ENGINE.

APPLICATION FILED AUG. 4, 1904.

3 SHEETS—SHEET 2.

Fig. 2.

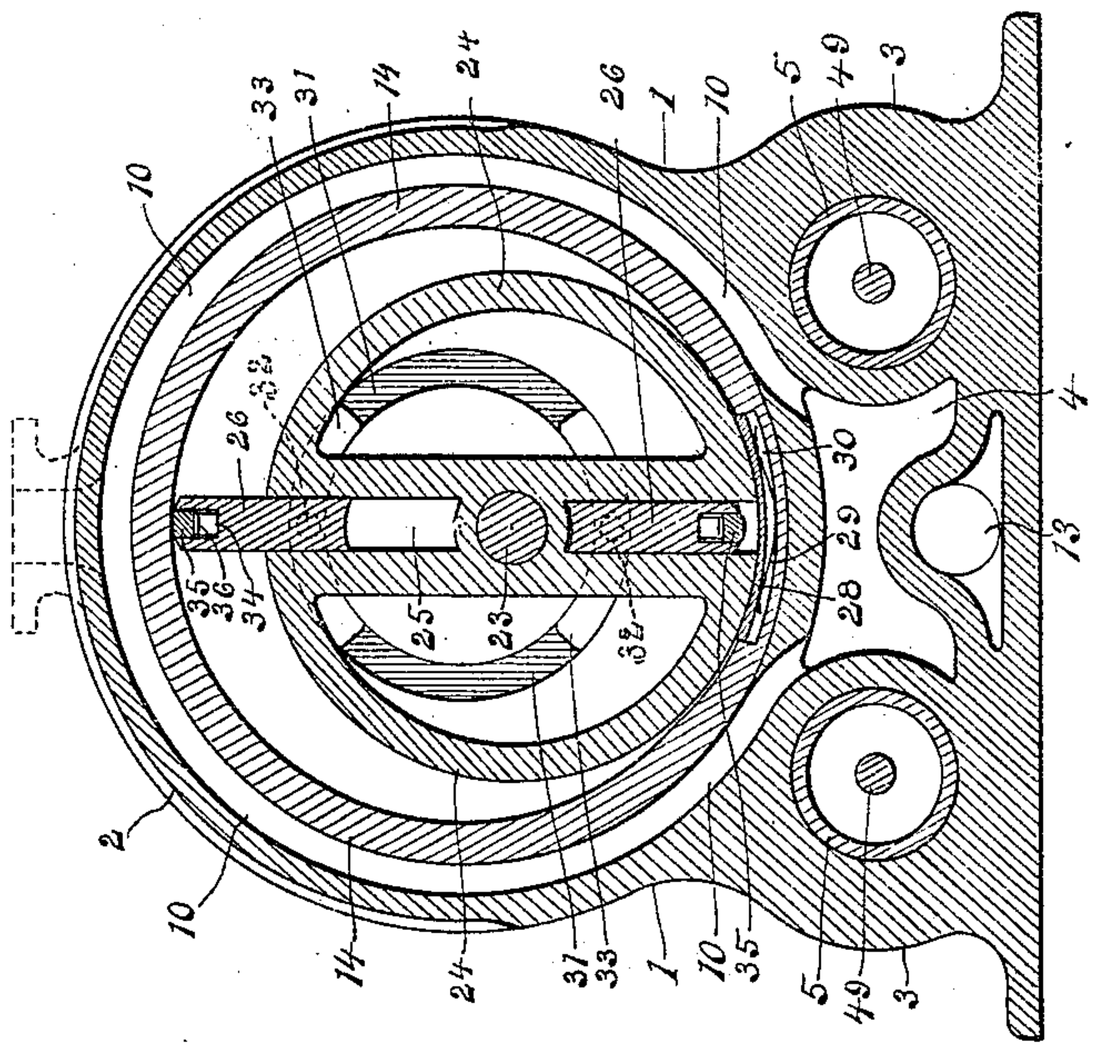
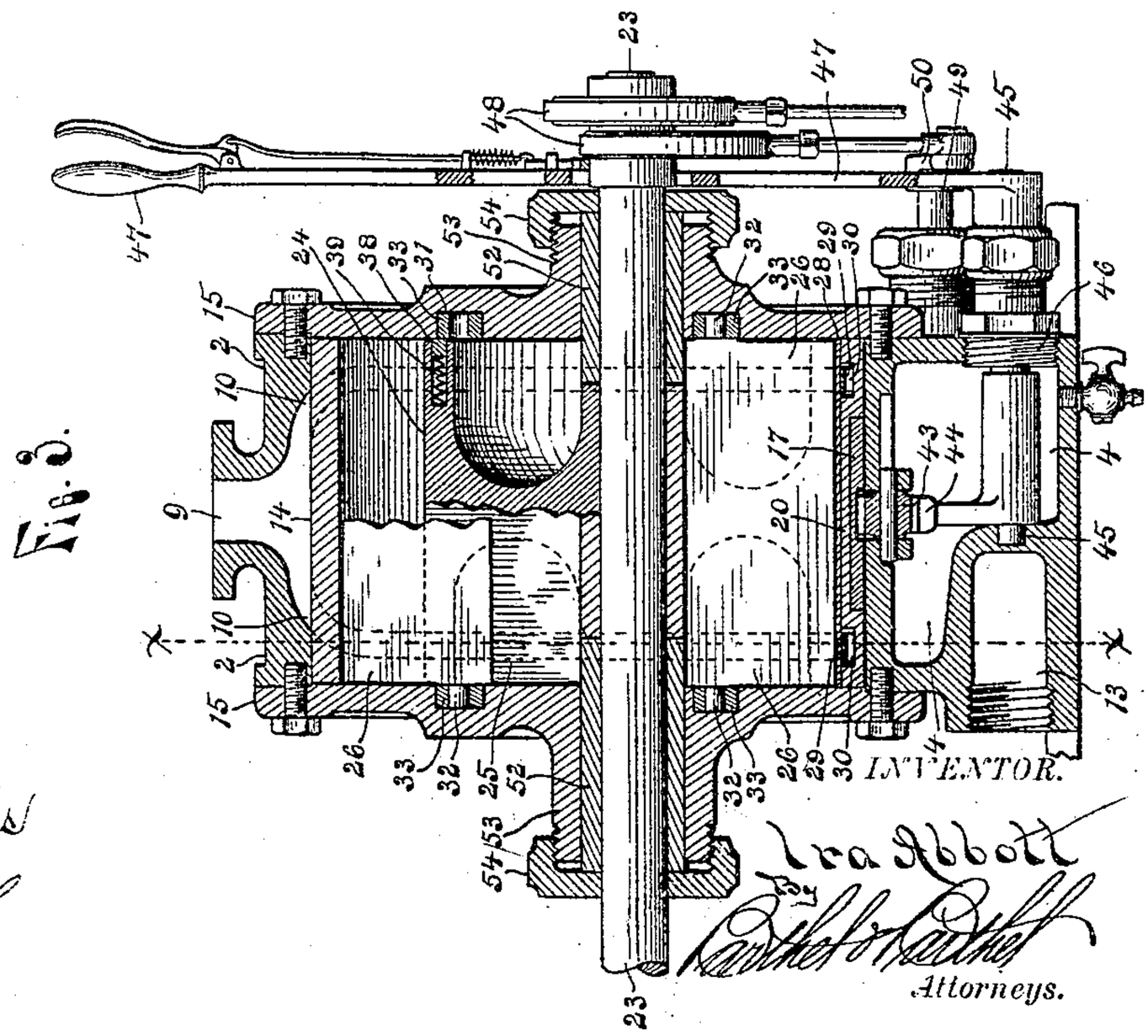


Fig. 3.



WITNESSES.

Lewis E. Flanders

Oliver C. Barthel

INVENTOR.

Ira Abbott

BY

Barthel & Barthel

Attorneys.

No. 816,285. PATENTED MAR. 27, 1906.

I. ABBOTT.

ROTARY ENGINE.

APPLICATION FILED AUG. 4, 1904.

3 SHEETS—SHEET 3.

Fig. 11.

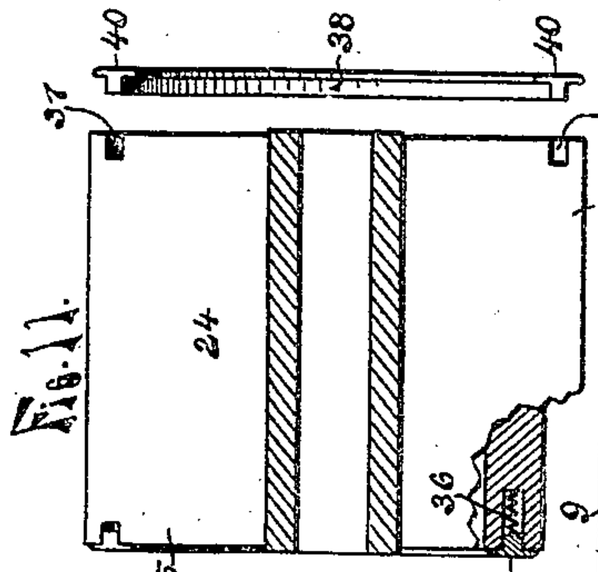


Fig. 10.

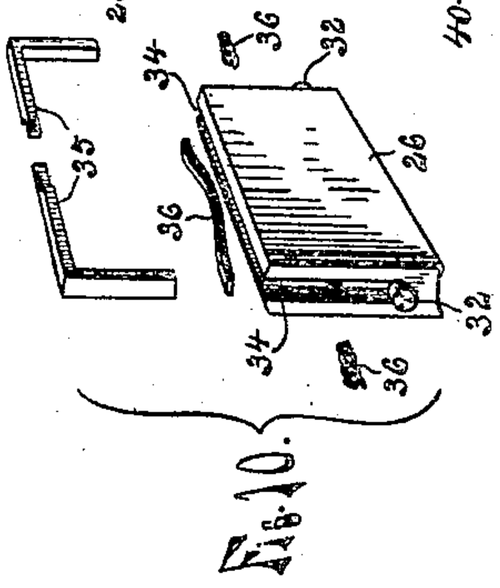


Fig. 5.

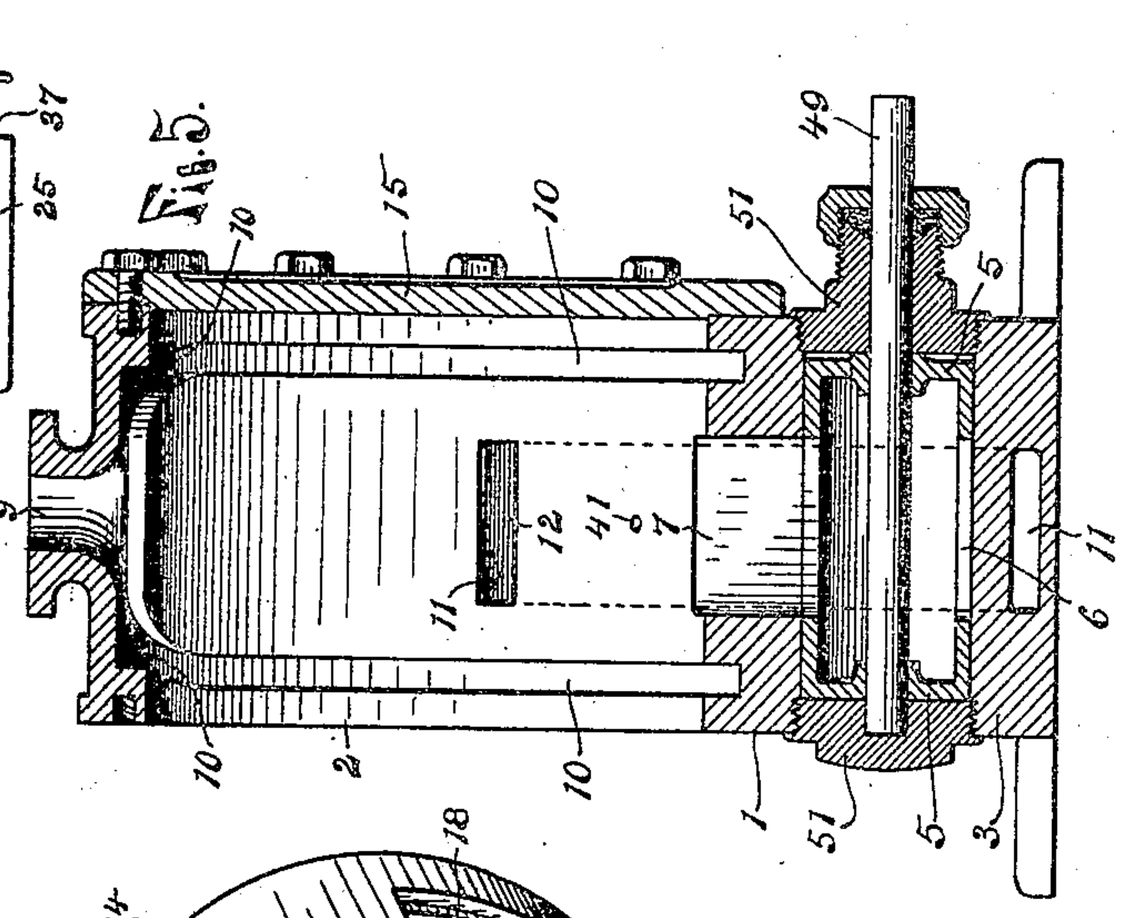


Fig. 9.

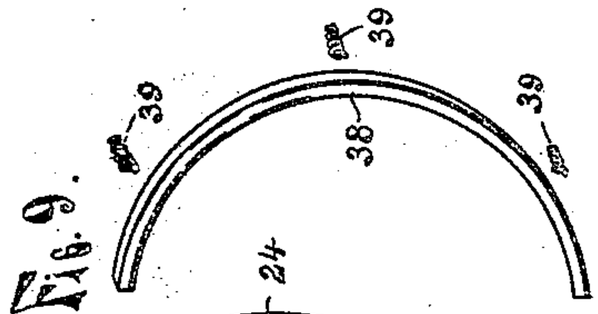


Fig. 8.

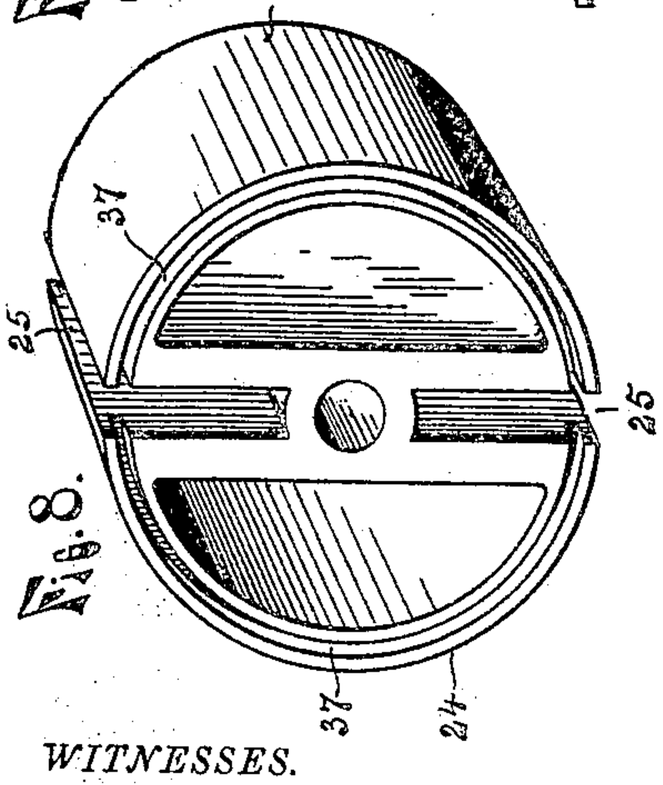


Fig. 6.

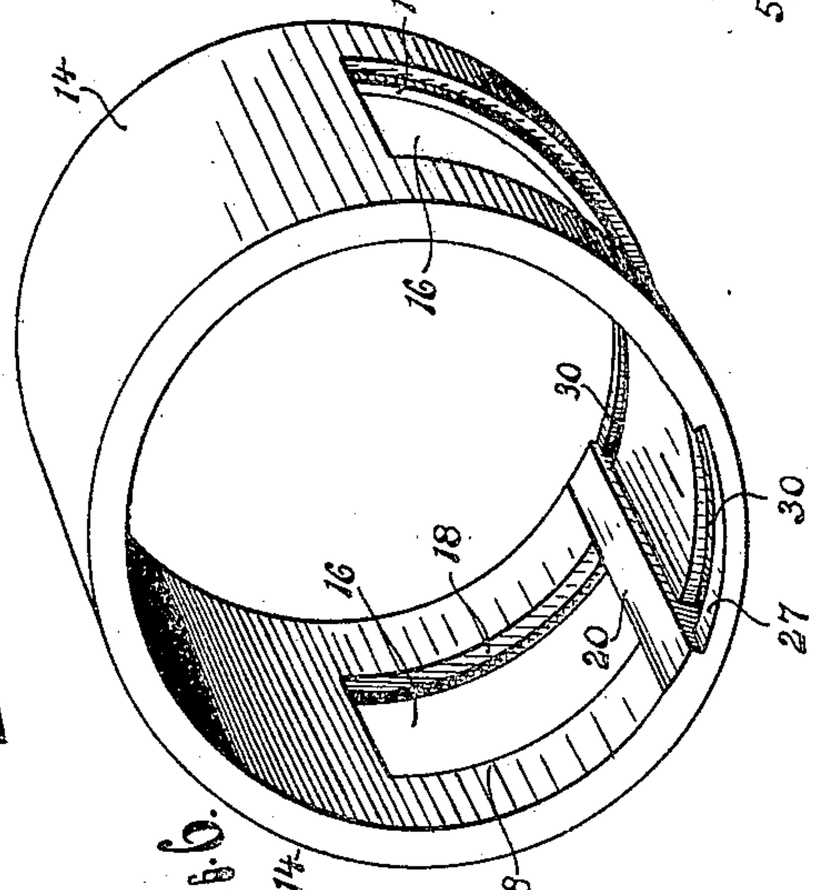
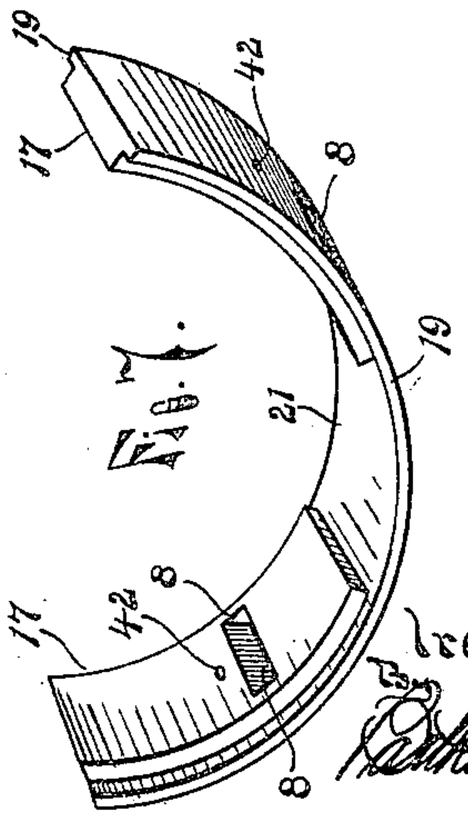


Fig. 7.



WITNESSES.

Lewis E. Flanders

Oliver C. Barthel.

INVENTOR.

Ira Abbott

By Barthel & Barthel

Attorneys.

UNITED STATES PATENT OFFICE.

IRA ABBOTT, OF WYANDOTTE, MICHIGAN.

ROTARY ENGINE.

No. 816,285. Specification of Letters Patent. Patented March 27, 1906.

Application filed August 4, 1904. Serial No. 219,456.

To all whom it may concern:

Be it known that I, IRA ABBOTT, a citizen of the United States of America, residing at Wyandotte, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Rotary Steam-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements in rotary steam-engines; and its object is to provide an engine of this type which is so constructed that the steam may be used expansively, and thus a maximum of power secured with the use of a minimum amount of steam, and to so construct the engine that it may be very easily and quickly reversed by simply moving a single lever.

It is also an object of the invention to prevent the unequal expansion of the casing and the condensation of the steam in the cylinder and valves by the peculiar arrangement of the steam-passages and to provide efficient means for packing the cylinder and its blades to prevent the steam from passing the same.

A further object of the invention is to economize space, securing a very small and compact engine developing a high horsepower, and to provide a very simple construction, cheap to manufacture and having other advantages of the particular arrangement, construction, and combination of parts, all as hereinafter more fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation of a device embodying the invention; Fig. 2, a vertical section of the same, showing the rotary cylinder in end elevation; Fig. 3, a central vertical section of the same, taken at right angles to that shown in Fig. 2. Fig. 4 is a section on the line $x\ x$ of Fig. 3; Fig. 5, a section of the casing on the line $y\ y$ of Fig. 2 with one of the heads and the internal parts removed to show the ports and passages. Fig. 6 is a perspective view of the bushing-ring detached; Fig. 7, a perspective view of the reversing-valve; Fig. 8, a perspective view of the rotary piston; Fig. 9, a detail perspective view of one of the packing-ring segments for said piston with its springs; Fig. 10, a detail perspective view of one of the piston blades or abutments, showing its packing-strip and springs separated therefrom; and Fig. 11 a section of the piston, showing a modified form of packing-ring segments.

1 is the casing bored out to form a cylinder 2 and formed with a base portion 3, which is provided with a chamber forming a steam-chest 4 and is bored transversely at each side of said chest to receive the inlet-valves 5. These valves are cylindrical in form, fitting closely in the bores provided in the casing, and are closed at both ends, an inlet-opening 6 being provided in one side of each, through which the steam enters through a passage from the steam-chest, said opening being of such a size that the valve may be turned approximately one-quarter of a revolution without cutting off the passage, so that the valves will always be full of live steam from the chest. Passages 7 are formed in the casing leading to the intake-ports 8 and with which the outlet-openings in the valves register as the valves are turned to admit steam to the cylinder.

A boss or flanged nipple is provided at the top of the cylinder, to which a steam-supply pipe may be attached in any suitable manner, and leading from the opening 9 in this boss are the steam-passages 10 in the form of grooves in the inner face of the cylinder extending downward each way from said opening adjacent to each end of the cylinder and communicating at their lower ends with the steam-chest. Exhaust-passages 11 are formed in the casing between the passages 10 and extend downward from the exhaust-port 12 in each side of the cylinder around the valves 5 to an exhaust-chamber 13 in the base, which chamber opens through the rear side of the base, and into this opening may be screwed an exhaust-pipe.

14 is a bushing-ring which is of the same length as and fits tightly within the bore of the cylinder, the cylinder-heads 15 setting hard against the ring when bolted in place, and the ring thus covers and forms one side of the steam-passages 10. Said ring is provided with a rectangular opening 16 at each side, extending from above the exhaust-ports 12 in the cylinder downward to and a short distance beyond the intake-ports 8 to receive the reversing-valve 17, adapted to slide longitudinally therein. Flanges 18 extend inward along each side of each opening at their inner edges, and flanges 19 on the sides of the valve at its outer edges engage the flanges 18 and hold the valve in place, the valve being placed in the ring before said ring is forced into the cylinder. Between the openings 16 is a web 20. The thickness of the flanges 18

and the middle portion 21 of the valve is cut away to extend beneath this web and connect the two end portions thereof, which are of the same thickness as the ring. These thickened end portions of the valve are shorter than the openings so as to permit the valve to move longitudinally, and ports or openings 8 of the same size as the passage 7 are provided in said end portions to register with the passages. These openings 8 are so positioned that when the valve is moved longitudinally in one direction to close the exhaust-port 12 at the side toward which the valve is moved and open the exhaust-port at the other side the opening in that end of the valve will register with its passage and the opening in the opposite end will be moved out of line with its passage, and thus the steam will enter at one side of the cylinder and escape at the opposite side.

Mounted in bearings on the heads 15 is the shaft 23 and secured on said shaft is a rotary piston 24 of a length to fit between the heads and provided with oppositely-extending longitudinal radial slots 25 to receive the blades or movable abutments 26, adapted to slide radially in said slots, said blades also being of a length to fit between the heads.

The piston is supported eccentrically within the cylinder by the shaft, the bearings of which are at a distance below the axes of the heads, and the inner face of the bushing-ring is cut away slightly at its lower side on a line concentric with the axis of the shaft to permit the insertion of the piston, which has a slightly greater radius than the distance from the axes of the shaft to the face of the ring directly below the shaft would be if the ring was not so cut away. The piston revolving in proximity to the bushing-ring at the bottom of the cylinder forms an abutment or wall at that point to prevent the steam from passing, and as the ring at this point is concentric with the axis of the piston the piston contacts the ring for a considerable distance, thus effectually preventing the steam from blowing through.

To provide for the unequal expansion of the piston and bushing-ring, the ring is cut away at 27, where the two come into proximity with each other, and a contact-plate 28 is inserted, said plate being held firmly against the piston by springs 29, one at each end of the plate, in grooves 30, provided therefor in the ring.

The piston-blades or movable abutments 26 are held in contact with the inner surface of the ring or bushing by providing a groove or way 31 in each cylinder-head 15, which grooves are concentric with the axis of the cylinder, and on the ends of each blade are provided outwardly-projecting studs or trunnions 32, engaging openings in the segmental guide-blocks 33, which slide freely in said ways. The blocks are held in their ways by the blades, which fit between the heads, and as the ways are concentric with the cylinder the blades are held constantly in contact with the face of the cylinder as they are carried around by the eccentric-piston.

A groove 34 is provided in the ends and outer edges of each blade, and in this groove is a packing-strip 35, consisting of two parts, each part formed of a bar bent at right angles to engage the groove in one end of the blade, the ends of the parts overlapping in the groove in the outer edge at the center of the blade. Springs 36 are interposed between the strip and the bottom of the groove, those in the groove in the outer edge holding the strip firmly against the face of the bushing-ring and those in the end grooves tending to separate the parts and holding the bent end portions of the strip firmly against the cylinder-heads. Each blade is thus packed to prevent the steam from passing the same, and to prevent the steam from leaking through between the ends of the piston and the cylinder-heads grooves 37 are provided in the ends of the piston to receive the packing-ring segments 38, the ends of each of which abut against the sides of the blades and the segments are held projected from their grooves to engage the cylinder-heads by coiled springs 39. As shown in Fig. 11, the ring-segments may be made in the form of a T in cross-section, the cross member forming an extended outer face 40 to contact the cylinder-head, and thus more effectually prevent leakage and wear.

In the walls of the casing between the exhaust-passages 11 and the interior of the cylinder are provided small holes 41 adjacent to the passages 7, and in the valve 17 are similar holes 42, adapted to register therewith, said holes in the valve being so positioned that when the valve is shifted to open the exhaust at one side the hole in that end of the valve will register with the corresponding hole in the casing, so that the air and steam which is trapped by the piston-blade in the angle formed by the junction of the piston with the bushing-ring, after said blade has passed the exhaust-port, may escape through said holes into the exhaust-passage, thus relieving the back pressure which would otherwise be caused thereby.

To shift the reversing-valve 17, teeth are cut in the under side of said valve intermediate its ends, and journaled in suitable bearings on the casing within the steam-chest 4 is a pinion 43, which extends upward through an opening in the casing and engage said teeth on the valve. A toothed sector 44, engaging said pinion to turn the same, is secured to a shaft 45, mounted at one end in a bearing on the casing and at its opposite end in a bushing 46, screwed into an opening in the forward side of the casing, through which opening the said sector is inserted, and an op-

erating-lever 47 is provided on the outer end of the shaft to turn the same.

The inlet-valves 5 are operated by eccentrics 48 on the engine-shaft 23, each eccentric being connected to the stem 49 of its valve by an eccentric-rod, which is pivotally attached to the end of an arm 50, secured on the valve-stem, and so by shifting the eccentrics relative to the movement of the piston the time of the opening and closing of the valves may be changed. The valves being hollow and in constant communication with the steam-chest turn very easily as the steam fills the same and presses outward in all directions alike, and owing to their cylindrical form the casing may be bored right through to receive the valves and the ends of the openings closed by the plugs 51, which form bearings for the valve-stems.

To center the piston between the cylinder-heads, a sleeve 52 is sleeved on the engine-shaft at each side of the piston, which sleeves extend outward through the outwardly-extending hub-bearings 53, and these hubs are externally screw-threaded at their outer ends to receive caps 54, which engage the ends of the sleeves and force the same inward against the ends of the hub of the piston, so that by adjusting the caps the piston may be moved and held centered, thus preventing it from contracting one head more than the other.

The reversing-lever being turned from a vertical position the inlet-port at one side and the exhaust-port at the opposite side of the cylinder are opened, and when steam is admitted to the steam-chest it will pass through one of the valves 5 and up through the passage 7 and port 8 into the cylinder, striking the piston-blade squarely, as shown in Fig. 2, the passage opening into the cylinder on a tangent to the piston. When the blade has moved to a point at a predetermined distance from the exhaust-port, the inlet-valve 5 closes and the blade is moved the rest of the distance to the exhaust-port by the expansive force of the steam, the point at which the steam will be cut off being determined by the position of the eccentrics 48, which position may be changed as desired. The ports are also so arranged relative to the piston that just before one blade reaches the exhaust-port the other blade passes the intake-port, and therefore there is a constant pressure on the blades, making a very still and smooth running engine, developing a very high horse-power in proportion to the amount of steam used and the size of the engine.

By providing a like arrangement of ports, passages, and valves at each side of the cylinder and the reversing-valve controlling said ports the engine may be reversed by simply shifting the reversing-lever, and the particular construction and arrangement of the parts gives a very neat, compact, and efficient device.

What I claim is—

1. In a rotary engine, the combination of a cylinder having its inner face cut away for a distance at its lower side to form a recess therein and provided with inlet and exhaust ports on opposite sides, heads on the cylinder provided with bearings below the axis of the cylinder, a shaft in said bearings extending longitudinally through the cylinder, a rotary piston provided with radial slots secured on said shaft, blades in said slots movable radially therein, studs on said blades, ways in the cylinder-heads arranged concentrically with the axis of the cylinder, blocks in said ways having openings to receive said studs, a contact-plate within said recess, and springs to hold said plate in contact with the piston to prevent the passage of the steam.

2. In a rotary engine, the combination with a cylinder having ports, of heads in the cylinder having outwardly-extending hub-bearings externally screw-threaded at their outer ends, a shaft in said bearings, a rotary piston secured to said shaft, sleeves on the shaft at each side of the piston engaging the hub of the same at one end and extended outward through the bearings, and internally-screw-threaded caps on the outer ends of the hub-bearings to engage the ends of the sleeves and force the same inward against the hub of the piston to center the same in the cylinder.

3. In a rotary engine, the combination with a cylinder having an inlet and an exhaust port, a rotary piston mounted eccentrically within the cylinder and forming an abutment, blades carried by said piston, a base portion having a chamber forming a steam-chest and bored transversely to form a valve-chamber communicating through passages with the steam-chest and inlet-port, a cylindrical valve in said valve-chamber open to the steam-chest and provided with an opening to register with the passage leading to the inlet-port, and means for rocking said valve in timed relation to the movement of the piston.

4. In a rotary engine, the combination of a cylinder having steam-passages formed in its inner face and leading around the same from an opening in its top and provided with inlet and exhaust ports between said passages, a bushing-ring covering the passages and provided with openings opposite the ports, a piston mounted eccentrically within the cylinder with one side engaging the ring between the ports, and means for opening and closing said ports.

5. In a rotary engine, the combination with a cylinder having an intake and an exhaust port at each side, a bushing-ring fitting within said cylinder and having openings opposite said ports, a slide-valve within said

openings in the ring to open and close said ports, a rotary piston mounted eccentrically within the cylinder with one side engaging the bushing-ring between the ports and forming an abutment, blades carried by said piston, and means for moving the valve.

6. In a rotary engine, the combination of a cylinder having steam-passages leading around the same from an opening at its top and provided with inlet and exhaust ports between said passages; a base portion having a chamber forming a steam-chest into which the steam-passages open, valve-chambers at each side of said chest communicating with said chest and with the inlet-ports, an exhaust-chamber, and exhaust-passages leading from the exhaust-ports to said exhaust-chamber around the valve-chambers and between the steam-passages; a rotary piston in said cylinder having blades; valves in the valve-chambers; and means for operating said valves.

7. In a rotary engine, the combination of a cylinder having an inlet and an exhaust port, at each side and having its inner face recessed adjacent to said ports, a slide-valve in said recess to control the ports, a rotary piston mounted eccentrically within the cylinder and contacting the face of the cylinder between its ports, blades carried by said piston, and means for moving the valve longitudinally in its recess.

8. In a rotary engine, the combination of a cylinder having an inlet and an exhaust port in each side, heads on said cylinder having bearings at one side of their axes, a shaft in said bearings, a rotary piston secured on the shaft and engaging the cylinder at one side to form an abutment, blades radially movable in said piston, studs on said blades, ways on the heads concentric with the axis of the cylinder into which ways the studs project, a longitudinally-movable valve in the face of the cylinder to cover the exhaust-ports at each side and provided with openings to register with the inlet-ports, a steam-chest below the cylinder, a shaft mounted in bearings on the walls of said chest, a sector on said shaft within the chest to operate the slide-valve, and a lever secured to the outer end of said shaft to turn the same to shift the valve.

9. In a rotary engine, the combination of a cylinder having an inlet and an exhaust port at each side and having its inner face recessed adjacent to said ports to receive a valve, a valve in said recess to open and close the ports, means for shifting said valve, heads on the cylinder provided with bearings at one side of the axis of the cylinder, a shaft in said bearings extending outward through the same, a rotary piston on said shaft contacting the face of the cylinder between its ports, blades carried by said piston in contact with the face of the cylinder, a base portion having a steam-chest and transverse bores at each side of said chest forming valve-chambers, passages being formed in the base connecting the chest and valve-chambers and the valve-chambers with the inlet-ports, cylindrical valves in the valve-chambers having stems extending outside the base, eccentrics on the engine-shaft, arms on the valve-stems, and connecting-rods connecting the eccentrics and arms.

10. In a rotary engine, the combination of a cylinder having an opening at its upper side, grooves in its inner face extending around the cylinder each way from said opening near each end of the cylinder, an inlet and an exhaust port at each side between said grooves communicating with inlet and exhaust passages, and a hole adjacent to each inlet-port communicating with the exhaust-passage; a base portion formed with a chamber forming the steam-chest, an exhaust-chamber into which the exhaust-passages lead, and valve-chambers at each side of the steam-chest communicating with the same and into which the inlet-passages open, and bored transversely through the casing; cylindrical valves having closed ends in said valve-chambers; plugs in the outer ends of the valve-chambers to close the same valve-stems extending through the plugs at one end; arms on the outer ends of said stems; a bushing-ring fitting within the cylinder to cover the grooves in the face thereof and formed with openings opposite the ports having inwardly-extending flanges; a longitudinally-movable valve to fit within said openings in the ring and provided with openings to register with the inlet-ports and also holes to register with the holes adjacent to said ports; heads on the cylinder provided with bearings arranged eccentrically with the axis of the cylinder; an engine-shaft in said bearings; a rotary piston secured on said shaft and provided with radial slots; blades in said slots, a contact-plate in the lower side of the cylinder engaging the side of the piston to form an abutment; a pinion mounted in bearings in the steam-chest and engaging teeth on the lower side of the slide-valve; a shaft mounted in bearings on the walls of the chest; a sector on said shaft engaging the pinion; a hand-lever on the outer end of said shaft; eccentrics on the engine-shaft; and connecting-rods connecting the eccentrics and the ends of the arms on the valve-stems.

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

IRA ABBOTT.

Witnesses:
FRANK M. SHOWALTER,
OTTO F. BARTHEL.