No. 711,092. Patented Oct. 14, 1902.

F. G. BATES.

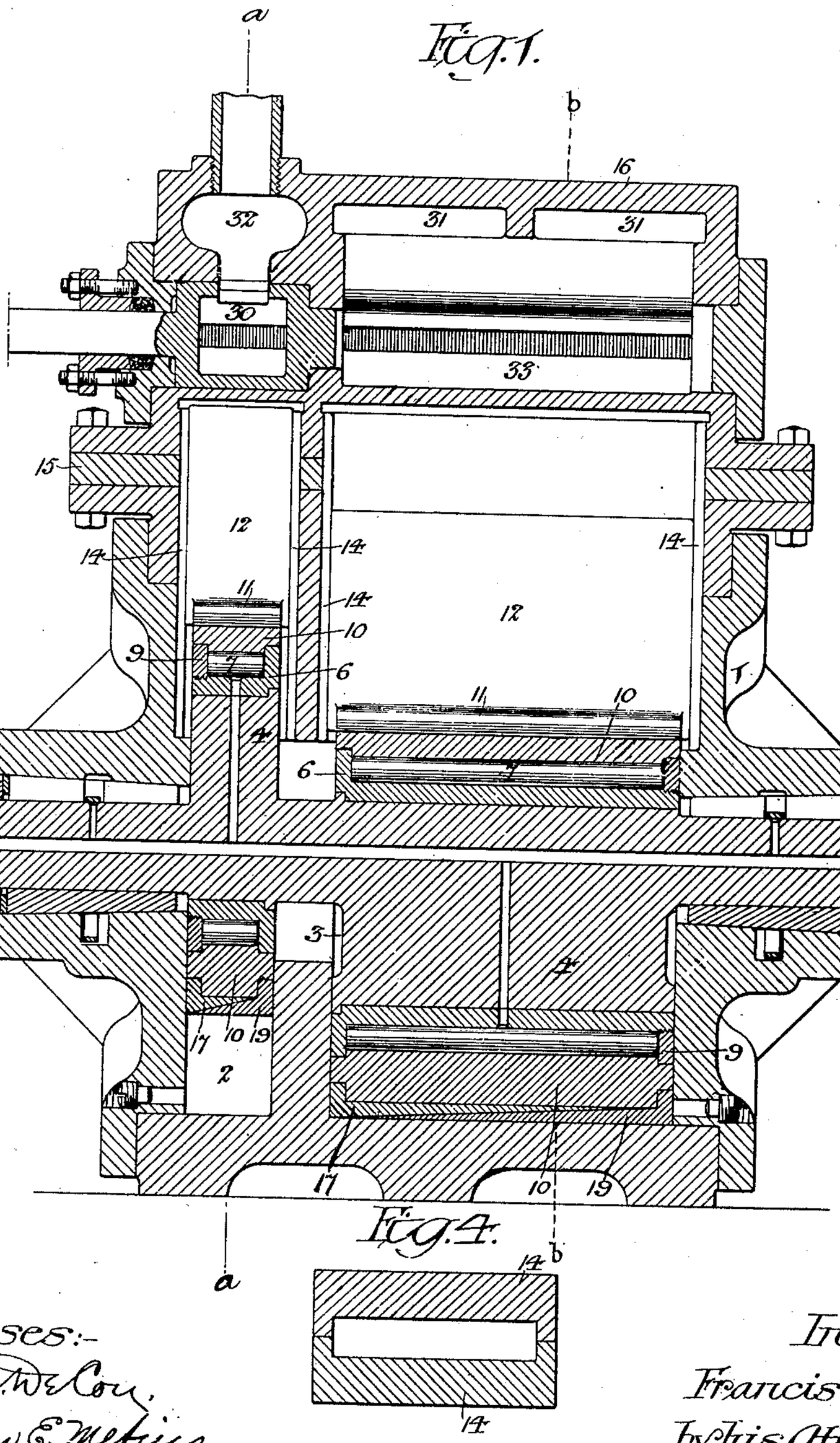
ROTARY ENGINE.

(Application filed Jan. 13, 1902.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.



Witnesses:-
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Inventor:
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3 Sheets—Sheet 2.

Fig. 2.

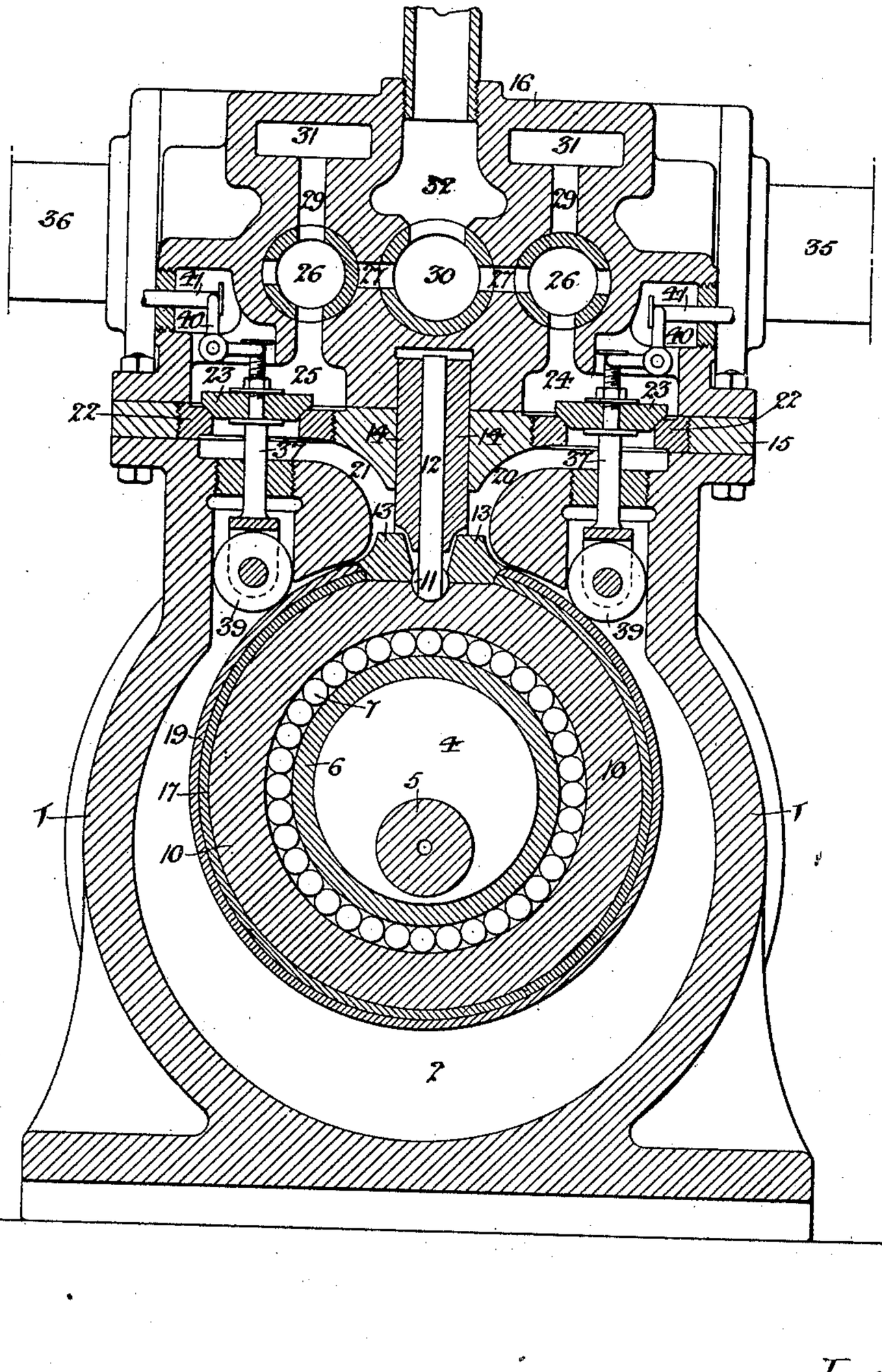

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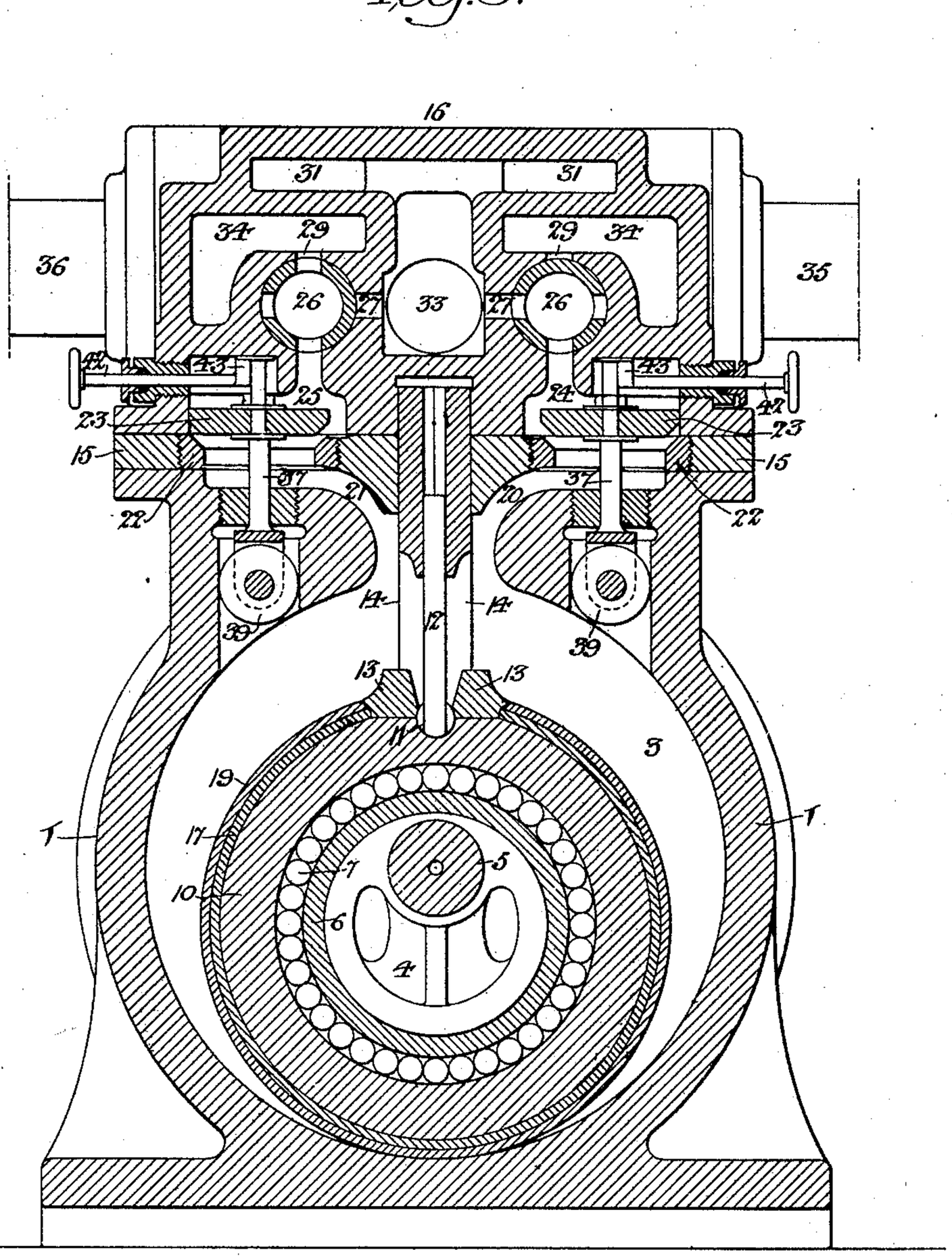
Fig. 3.



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UNITED STATES PATENT OFFICE.

FRANCIS G. BATES, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 711,092, dated October 14, 1902.

Application filed January 13, 1902. Serial No. 89,546. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS G. BATES, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Rotary Engines, of which the following is a specification.

My invention consists of certain improvements in rotary steam-engines of the type for which I have obtained Letters Patent No. 617,072, dated January 3, 1899, and have filed application Serial No. 60,378, dated May 15, 1901, my present invention comprising certain features of valve mechanism and constructive detail whereby the operation of the engine is improved and in the case of multiple compound engines provision is afforded for obtaining varying degrees of power by varying the system of expansion.

In the accompanying drawings, Figure 1 is a longitudinal section of a rotary engine constructed in accordance with my invention. Fig. 2 is a transverse section on the line *a a*, Fig. 1. Fig. 3 is a transverse section on the line *b b*, Fig. 1; and Fig. 4 is a sectional plan view, on an enlarged scale, of one of the parts of the engine.

1 represents the cylinder structure of the engine, in which in the present instance are two piston-chambers 2 and 3, one of smaller longitudinal dimensions than the other for the reception of a small high-pressure piston, the larger chamber receiving a larger or low-pressure piston. Each piston consists of an eccentric 4, formed integral with or suitably secured to the shaft 5, this eccentric having secured to its periphery a flanged ring 6, which serves as the inner race for a series of anti-friction-rollers 7, which are held in place longitudinally by means of a ring 9, screwed onto the threaded end of the flanged ring 6, so as to form an opposite retaining-flange for said rollers.

Mounted upon the rollers 7 is a piston-ring 10, which as the eccentric 4 rotates is caused to swing from side to side and also to rise and fall, so that all portions of the periphery of said ring are successively brought into contact with the bore of the cylinder or piston chamber.

At the top of the piston-ring 10 is a recess for the reception of the lower portion of a cylindrical enlargement 11 at the lower end of a sliding plate 12, which is confined to the piston-ring by means of blocks 13 flanking said slide and overlapping the enlarged head of the same, so that while the piston-ring is confined to the slide so far as vertical movement is concerned it can swing laterally on the cylindrical lower end of the head of the slide.

The blocks 13 are secured to the piston-ring and extend upwardly beyond the periphery of the same in order to provide increased bulk for resisting the strains to which they are subjected and reduce the clearance in the inlet and exhaust passages of the engine.

The sliding plate 12 is contained between bushings 14, of hardened steel or other material presenting a good wearing-surface, these bushings being shaped as shown in cross-section in Fig. 4 and comprising portions which flank the plate 12 and have end flanges meeting at the ends of said plate, so as to form a chamber in which the sliding plate can move, the bushings fitting snugly in openings formed in the top plate 15 of the cylinder structure and in the valve-chest structure 16, which is mounted above the same.

Each piston-ring is provided with a pair of peripheral packing-rings 17 and 19, transversely beveled and having their beveled faces fitting one against the other, each ring also having an edge flange adapted to a groove in the side of the piston-ring, as shown in Fig. 1. By reason of this construction radial pressure upon the piston-rings tends to spread the rings laterally, so as to maintain their flanges in snug contact with the side walls of the piston-chamber, and thus prevent leakage of steam past the rings.

The continuity of the packing-rings is interrupted for the reception of the blocks 13, whereby the sliding plate 12 is connected to the piston-ring, as shown in Fig. 2, said blocks overlapping the ends of the rings, so as to prevent displacement of the same.

The cylinder structure has for each of the piston-chambers therein two passages 20 and 21, one communicating with the piston-chamber on one side of the separator-plate 12 and the other on the opposite side of the same, either of which passages may serve as the inlet-passage for motive fluid and the other as an

outlet or exhaust passage, and in the cap-plate 15 of the cylinder structure are rings 22, having openings communicating with the passages 20 and 21, respectively, each of these rings constituting a seat for a valve 23, one contained in a chamber 24 of the valve-chest and the other in a chamber 25 of the same.

The chamber 24 communicates with a valve 26, having three ports, so that by proper adjustment of said valve the chamber 24 may be placed in communication either with a lateral passage 27 or a vertical passage 29. The passage 27 leads to a central chamber containing a valve 30, and the passage 29 leads to an upper chamber 31. In like manner the chamber 25 communicates with a similar valve 26, having three ports, so that said chamber 25 can be placed in communication either with a lateral passage 27 or a vertical passage 29, the passage 27 communicating with the valve 30 and the passage 29 communicating with a top chamber 31. The valve 30 has three ports, two communicating with the passages 27 and the other with a live-steam chamber 32 at the top of the valve-chest. Precisely the same arrangement of valves and passages is employed in connection with the low-pressure-piston chamber 3, except that the valve 30 is dispensed with, the chambers 31 communicate with a receiver 33, which is in constant communication with the passages 27, and the passages 29 communicate with chambers 34, which are in communication, respectively, with the exhaust-pipes 35 and 36.

From each of the valves 23 extends downwardly a stem 37, which is forked at the lower end and carries an antifriction-roller 39, the latter projecting into the piston-chamber, so that as the piston swings in one direction it will open one of the valves and when it swings in the opposite direction it will open the other valve. As a consequence of this the valve which closes the inlet-chamber of the engine will be opened only for a limited portion of the stroke of the piston, so as to provide an automatic cut-off, this being true irrespective of the direction of rotation of the piston. In order, however, to provide for starting the engine, as well as to throw this automatic cut-off device out of action when desired—as, for instance, in the case of the low-pressure piston—independent means of lifting the valves 23 are provided. The means shown in Fig. 2 comprise bell-crank levers 40, each having one arm engaging a flange on the valve-stem 37 and another arm engaging a flange on a rod 41, which passes through a suitable stuffing-box in a plug on the valve-casing and is provided with any convenient means for operating it so as to raise the valve 23 from its seat.

The valve-operating device (shown in Fig. 3) comprises a rotary stem 42, having at the inner end an arm 43, which acts upon the flange on the valve-stem to lift the valve from its seat.

Supposing that the valves 26 and 30 are adjusted to the position shown in Fig. 2, the live steam or other motive fluid will enter the valve 30 and will be directed thereby to the valve 26, which operates in connection with the chamber 24, through which valve it will pass to the chamber and thence to the inlet-passage 20 of the high-pressure-piston chamber 2 of the engine, the motive fluid being exhausted from said chamber through the passage 21, chamber 25, and valve 26 to the chamber 29, from which it passes into the receiver 33, thence to the supply-chamber 24 of the low-pressure-piston chamber, and after operating the piston therein passes through the chamber 25, valve 26, and chamber 34 to the exhaust-pipe 36. By imparting a quarter-turn to each of the valves 26 the conditions are reversed, the passages 21 now becoming the inlet-passages, the passages 20 the exhaust-passages, and the pipe 35 the exhaust-pipe, so that a reversal in the direction of rotation of the pistons is effected. The valve 30 can be used as a throttle-valve for regulating or cutting off the flow of motive fluid to the engine.

In that class of engines having a number of piston-chambers disposed side by side and of different dimensions the valves controlling the flow of motive fluid to and from the respective piston-chambers may be so disposed as to use any desired number of same as high-pressure chambers and the others as low-pressure chambers or so as to use the motive fluid by a gradual system of expansion from end to end of the series, thereby varying the power of the engine in accordance with the requirements upon it and when necessary effecting the expansion of the motive fluid to extreme limit.

A crank-pin is considered the equivalent of the eccentric in those combinations in which said eccentric forms an element.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. A rotary engine having a piston-ring mounted upon an eccentric and swinging upon a sliding separator-plate, said separator-plate having a cylindrical end seated in the piston-ring and retainer-blocks secured to the piston-ring and overlapping said cylindrical end of the separator-plate, said retainer-blocks projecting radially beyond the periphery of the piston-ring, substantially as specified.

2. A rotary engine having a piston-ring mounted upon an eccentric and hung to a sliding separator-plate, said ring having packing-rings mounted upon the periphery of the same and provided with transversely-beveled faces in contact with each other, substantially as specified.

3. A rotary engine having a piston-ring mounted upon an eccentric and having swinging connection with a sliding separator-plate, said piston-ring having a pair of packing-rings mounted upon the periphery of the same

and provided with transversely-beveled contact-surfaces and edge flanges adapted to grooves in the sides of the piston-ring, substantially as specified.

4. A rotary engine having a piston-ring mounted upon an eccentric and having swinging connections with a sliding separator-plate, and a casing having a motive-fluid-supply chamber communicating with the piston-chamber and having a valve controlling the flow into the latter, said valve having a stem projecting down into the piston-chamber so as to be actuated by the piston in its movement in order to raise the valve for a limited portion of the stroke of piston, substantially as specified.

5. A rotary engine having a piston-ring mounted upon an eccentric and having swinging connection with a sliding separator-plate, a casing having a motive-fluid-supply chamber communicating with the piston-chamber and having a valve controlling the flow into the latter, said valve having a stem projecting down into the piston-chamber and forked at the lower end and a roller mounted in said forked lower end of the valve-stem and adapted to contact with the piston so as to raise the valve and hold the same open during a limited portion of the stroke of the piston, substantially as specified.

6. A rotary engine having a piston-ring mounted upon a rotating eccentric and having swinging connection with a sliding separator-plate, a casing having a motive-fluid-supply chamber communicating with the piston-chamber, a valve controlling the flow into the latter and having a stem projecting down into the piston-chamber so as to be actuated by the piston in its movement, and means for raising said valve independently of the piston action, substantially as specified.

7. A rotary engine having a piston-ring mounted upon a rotating eccentric and having swinging connection with a sliding separator-plate, and bushings flanking said plate and having end flanges meeting each other at the ends of the plate, substantially as specified.

8. A rotary engine having high and low pressure piston-chambers, pistons therein hung to a sliding separator-plate, a motive-fluid-inlet chamber for the high-pressure piston-chamber, a motive-fluid receiver for the low-pressure-piston chamber, an exhaust-chamber, a pair of high-pressure reversing-valves constructed to communicate either with the motive-fluid-inlet chamber and the high-pressure-piston chamber or with the latter and the low-pressure receiver, and a pair of low-pressure reversing-valves constructed to communicate either with the receiver and the low-pressure-piston chamber or with the latter and the exhaust-chamber, substantially as specified.

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

FRANCIS G. BATES.

Witnesses:
F. E. BECHTOLD,
JOS. H. KLEIN.