(No Model.) 3 Sheets—Sheet 1.

I. M. JOHNSON.

ROTARY ENGINE.

No. 600,914. Patented Mar. 22, 1898.

Fig. 1.

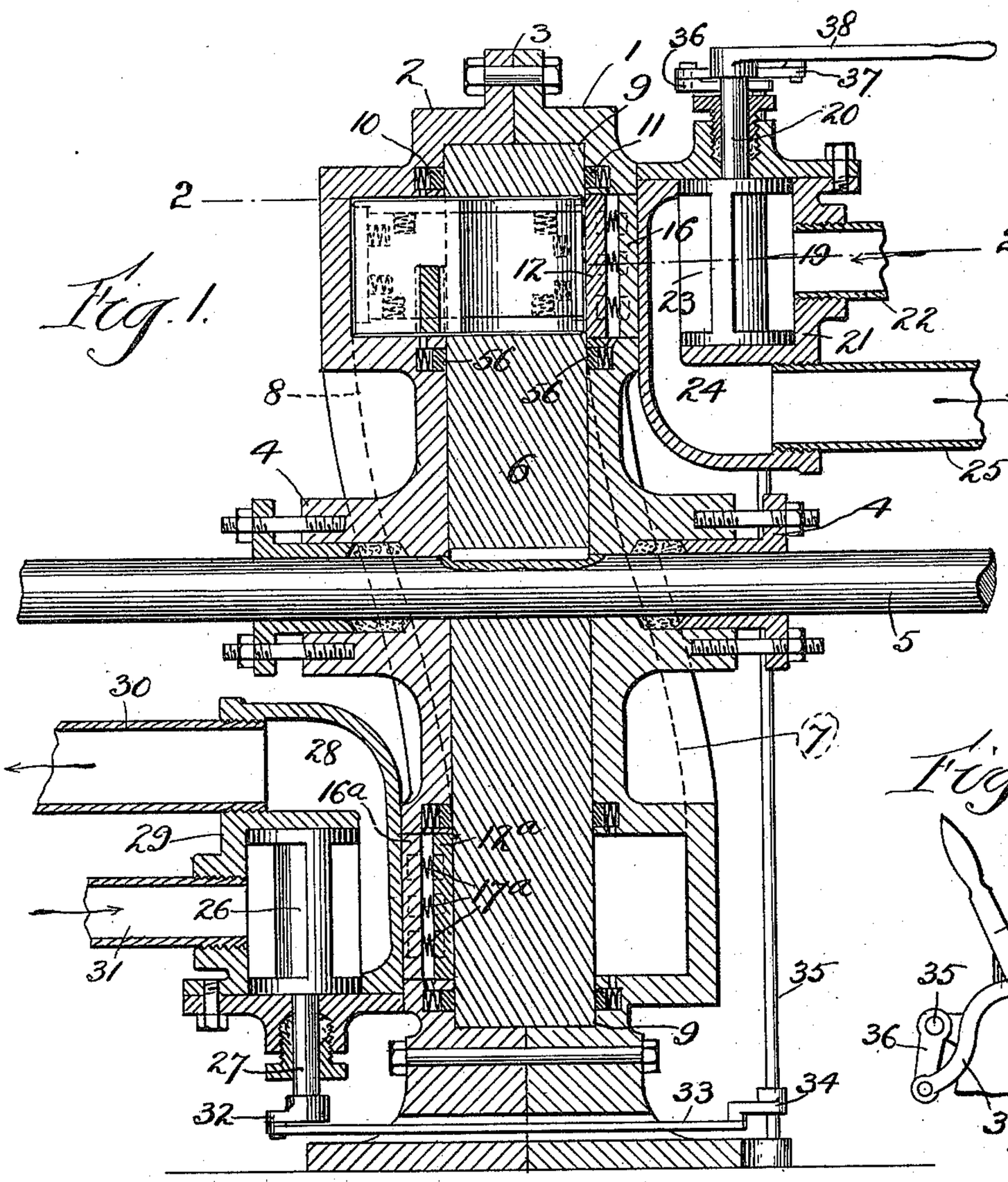
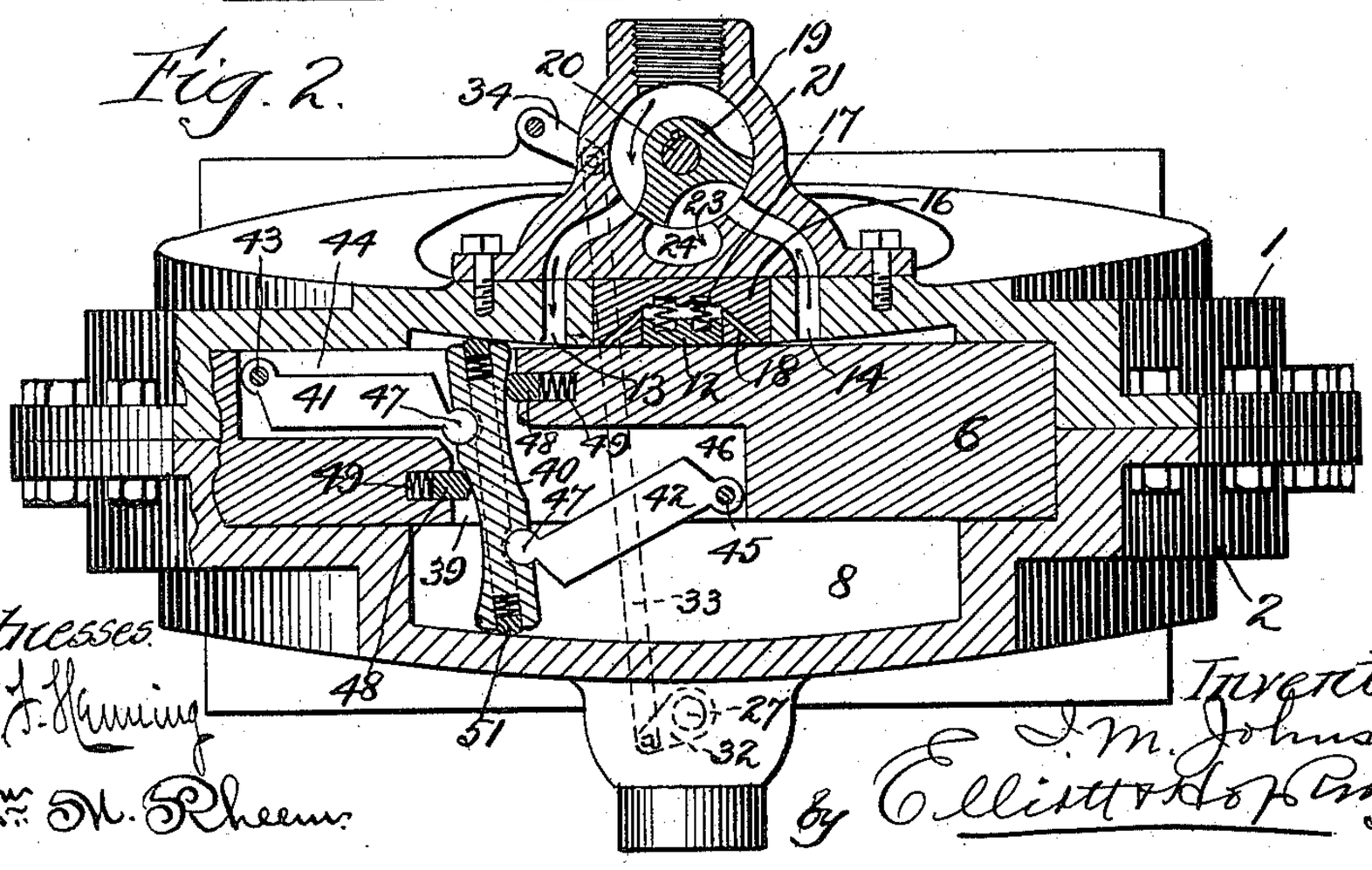


Fig. 3.

Fig. 2.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

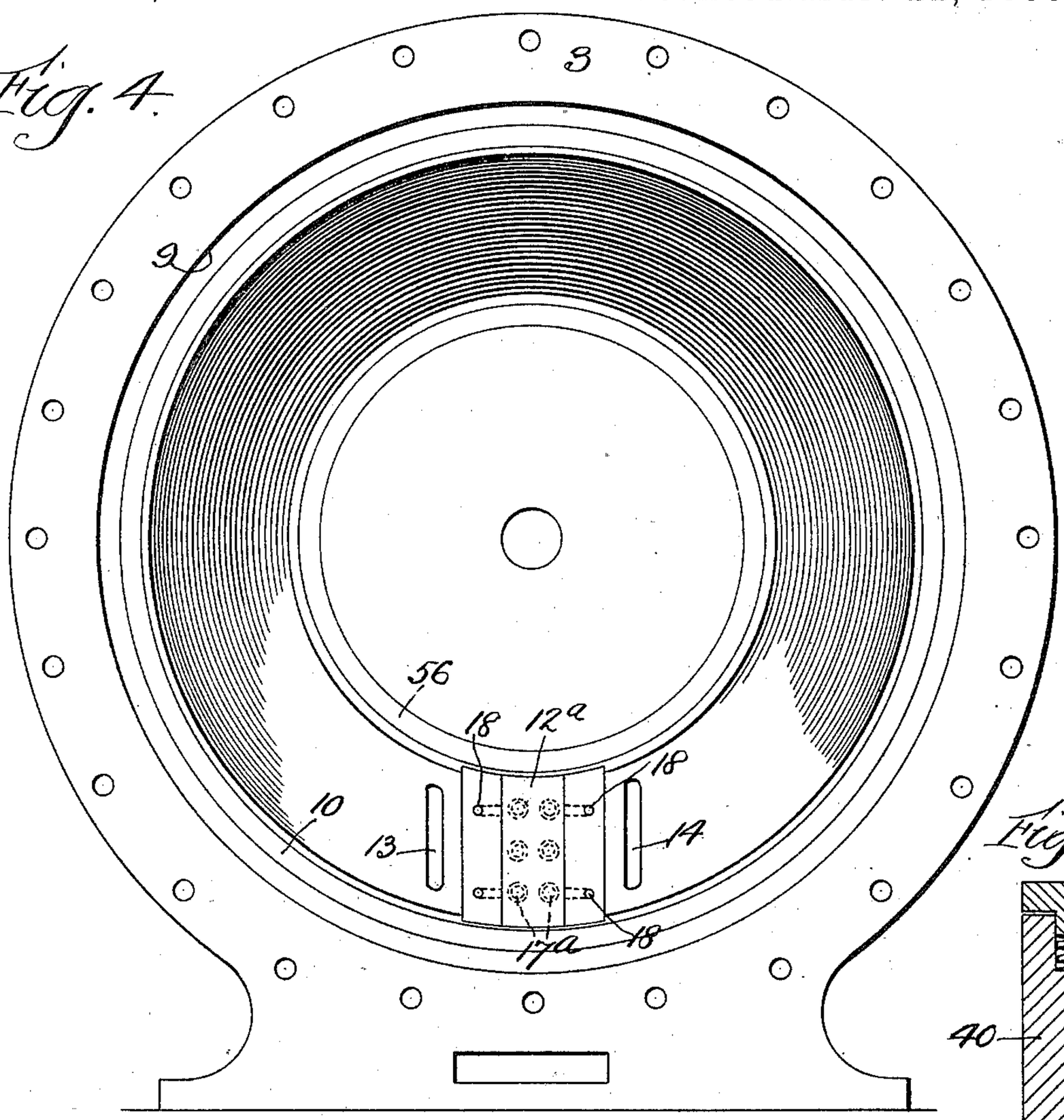

Fig. 5a

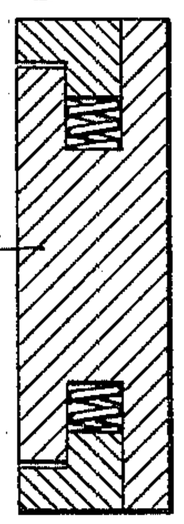

Fig. 5.

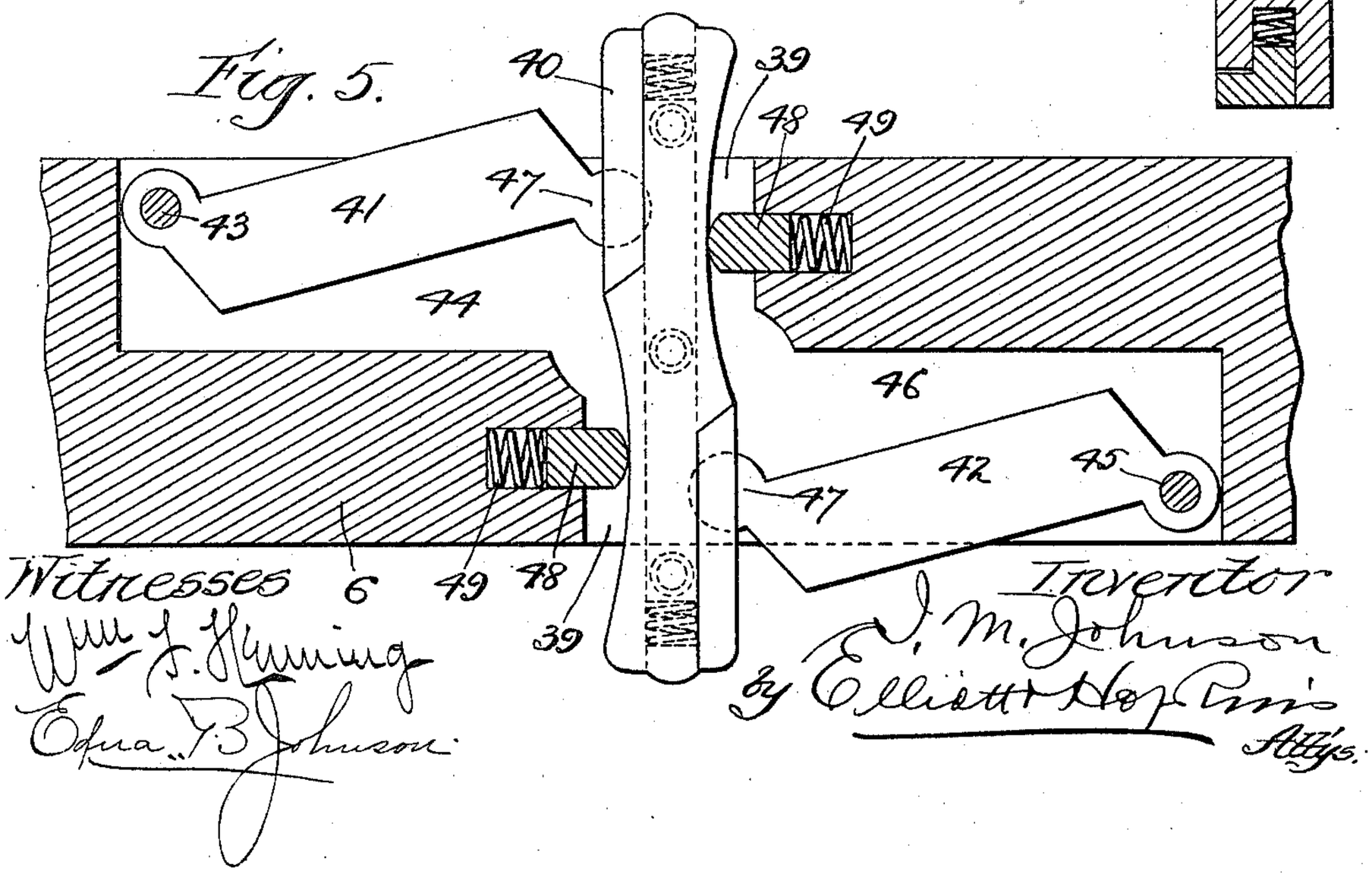

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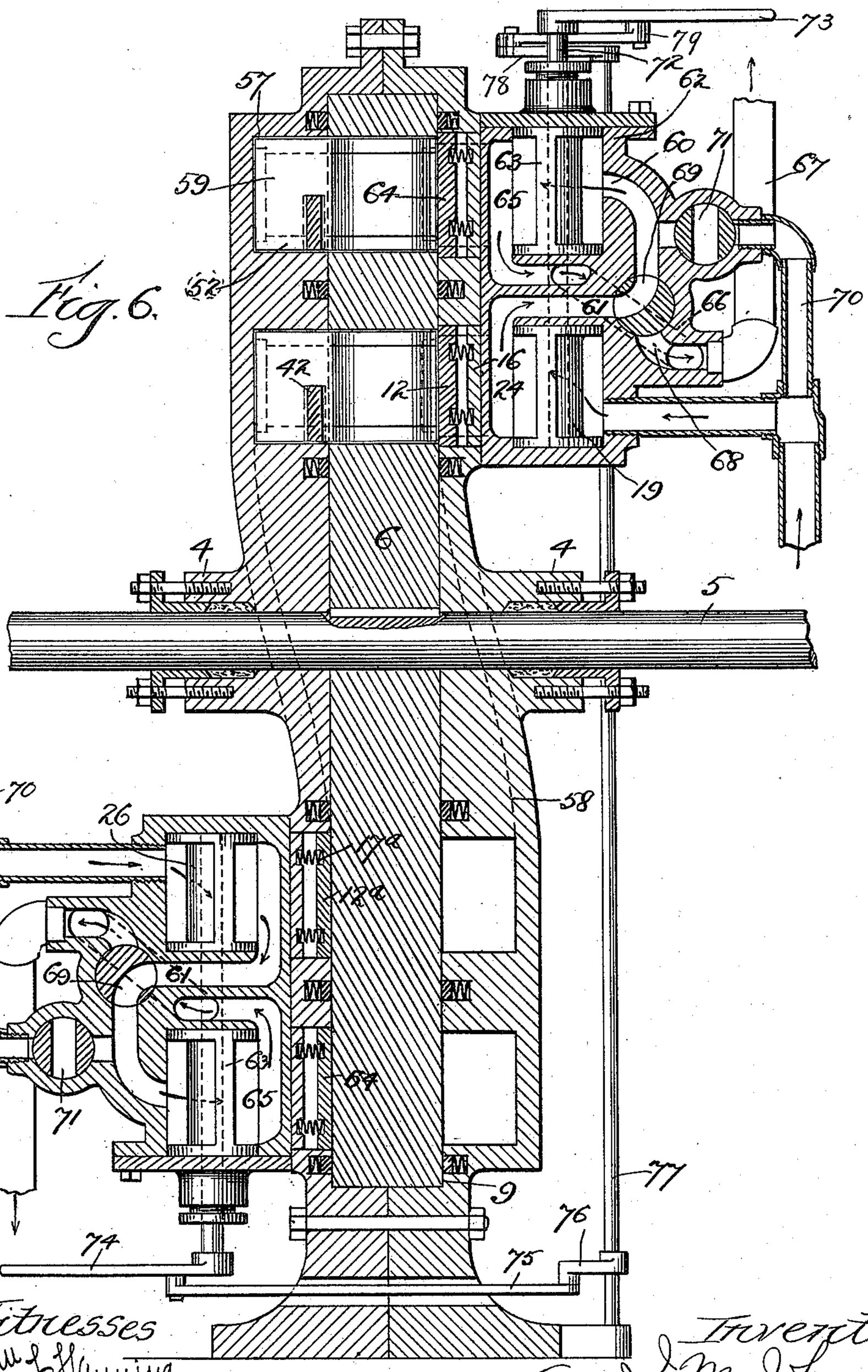
Fig. 6.



Witnesses
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UNITED STATES PATENT OFFICE.

ITHUEL M. JOHNSON, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 600,914, dated March 22, 1898.

Application filed December 12, 1896. Serial No. 615,502. (No model.)

To all whom it may concern:

Be it known that I, ITHUEL M. JOHNSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rotary Engines, of which the following is a full, clear, and exact specification.

My invention relates to that class of rotary engines in which the piston is movable independently of its carrying-disk and one wall of the steam-space or piston-way converges to a point of contact with the piston-disk, so as to constitute in conjunction therewith the necessary abutment or closure of the space; and my invention has for its primary object to provide an improved engine of this character in which the pressure upon the piston shall be balanced so as to reduce to the minimum the friction ordinarily resulting from the independent movement of the piston while under pressure.

Another object of my invention is to provide an improved construction whereby any point of the circumference of the piston-disk at which the piston may be situated may be kept under constant rotative pressure.

Another object of my invention is to utilize a plurality of steam-spaces or piston-ways adapted to take steam at different points with reference to their circumference in conjunction with a unitary piston adapted to project alternately into these spaces or piston-ways.

A still further object of my invention is to divide the interior of the casing or cylinder into a plurality of steam-spaces or piston-ways by means of a rotary partition or piston-disk, one of whose faces forms one wall of each of said piston-ways, while the opposite wall in each way shall gradually converge to a point of contact with the dividing-disk, and to provide such disk with a vibrating piston whose ends shall follow the line of the converging walls and project alternately into the piston-ways or steam-spaces thus formed.

With these ends in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said objects and certain other objects, hereinafter appearing, are attained, all as fully described with reference to the accompanying drawings and more particularly pointed out in the claims.

In the said drawings, Figure 1 is a vertical axial section of my improved engine. Fig. 2 is a plan view taken on the line 2 2, Fig. 1. Fig. 3 is a detail plan view of the valve-operating mechanism. Fig. 4 is an inner face view of one side of the casing. Fig. 5 is an enlarged plan of the piston and its arms. Fig. 5ª is a cross-section of the piston; and Fig. 6 is a view similar to Fig. 1, illustrating the embodiment of my improvements in a compound engine.

In carrying out my invention I provide the cylinder or casing of the engine with a steam-space or piston-way, in which I locate the piston-disk in such manner that its plane extends approximately diagonally across such space and divides it into two steam-spaces or piston-ways, each converging to a point of contact with opposite faces of the disk and at substantially opposite points with reference to the circumference of the disk, and each of these piston-ways is provided at its point of contraction with a steam-inlet and steam-exhaust, while the disk is mounted upon a shaft, as usual, and is provided with a unitary piston arranged to vibrate through an opening therein, and thus project alternately into the piston-ways or steam-spaces on opposite sides of the disk. In this manner the piston-disk at the point where the piston is located is always under rotative pressure, because while the piston on one face of the disk is passing the exhaust-port the piston protruding from the opposite face is extended into the wider portion of the opposite piston-way and is receiving pressure from the full head of steam in a greater or less degree, and it is also seen that no matter where the piston may be it is always presenting its maximum and a uniform area to the steam-pressure.

Referring now more specifically to the drawings, the casing or cylinder is preferably constructed of two halves or members 1 2, secured together by bolted flanges 3 in the ordinary manner and having on each side a suitable stuffing-box 4, through which the shaft 5 passes, as usual. Keyed to the shaft 5 and fitted snugly between the members 1 and 2 of the casing or cylinder is the piston-disk 6,

and formed in the outer wall of each of the members 1 and 2 is a steam-space or piston-way 7 8, respectively, which, though concentric with the piston-disk 6, are of smaller diameter than such disk, so that the latter will project slightly beyond them, as shown at 9, and thus afford room for the accommodation of concentric packing-rings 10 11, arranged in the inner face of each of the members 1 and 2 and bearing against the opposite faces of the disk 6 and in this way preventing the steam in one of the piston-ways 7 8 from escaping into the other around the periphery of the piston. One of these piston-ways 7 8, the one 7, gradually diverges from a point of contact with one face of the disk 6, as clearly shown in Fig. 2, in both directions and widens outwardly or to the right, as viewed in Fig. 1, until its maximum width or axial depth is reached. Where the wall of the way 7 comes into contact with the face of the disk 6, it forms in conjunction with such disk the abutment for preventing the steam from escaping directly to the exhaust-port, and it is preferable to locate at this point some suitable packing-block for making the parts steam-tight. For this purpose I have shown a packing-block 12, which is located between the ports 13 14, one of which constitutes the inlet, while the other the exhaust, port. This block is preferably situated within a cavity 15, formed in a removable section 16 and having a number of springs or cushions 17 for pressing it outwardly against the face of the disk 6. The block 16 is also provided with a number of ducts 18 for admitting steam behind the block 12 and thus balancing the steam-pressure and permitting the springs 17 to make the preponderance of pressure in the outward direction. The other steam-space or piston-way 8 starts from a point of contact with the opposite face of the piston 6 and at a point substantially diametrically opposite the packing-block 12, or, in any event, at a point remote from the packing-block 12 with reference to the circumference of the disk 6, and from such point of contact with the disk the outer wall of the space or way 8 gradually diverges or widens in both directions until the maximum axial width or depth is reached, and which depth in the example of my invention shown in the drawings is directly opposite the point of minimum depth of the steamway 7 or, in other words, directly opposite the packing-block 12. The wall of the steam-space or piston 8, where it comes into contact with or close propinquity to the face of the disk 6, is also provided with a packing-block 12^a and removable section 16^a, having the springs 17^a, constructed and operating in the manner described with reference to the portions 12, 16, and 17, before described. The removable section 16^a may also, if desired, be provided with steam-ducts 18^a for admitting pressure behind the packing-block 12^a in the manner before described with reference to the ducts 18.

The packing-block 12^a is also located between two ports 13^a 14^a, similar to the ports 13 14, one of which constitutes the inlet, while the other the outlet or exhaust, for the steam-space or piston-way 8. These exhaust and supply ports at the top of the cylinder or casing are guarded or governed by a valve 19, having a vertical valve-stem 20 and being situated in a valve box or casing 21, to which the supply-pipe 22 is connected. The valve 19 is provided with a cavity 23, which is adapted to place either of the ports 13 14 in communication with an exhaust-port 24, extending from the bottom of the casing 21 and communicating with any suitable exhaust-pipe 25. Thus either of the ports 13 14 may be made to serve as the supply-port, according to the direction in which it is desired to run the engine. The exhaust and supply ports 13^a 14^a at the lower opposite side of the cylinder or casing and which, as before described, are located one on either side of the packing-block 12^a, the same as the ports 13 14, are governed by a valve 26, which is similar in construction and arrangement to the valve 19, excepting that its stem 27 extends downwardly, whereby it may be in convenient position to be connected by suitable operative mechanism with the valve 19, so that the two valves may be moved in unison when the engine is reversed or the steam shut off by bringing the valve-faces over the ports 13 14, respectively. This also makes it desirable to extend the lower exhaust-port 28 out through the upper side of the lower valve-casing 29, 30 being the exhaust-pipe, while 31 the supply-pipe, extending from and to said casing, respectively. This operative connection between the two valves may be conveniently accomplished by providing the valve-stem 27 with a crank 32, connected by rod 33 with a crank 34 on a vertical shaft 35, at whose upper end is located a crank 36, which is connected by a link 37 with the valve-lever 38, the latter being secured directly to the upper end of the valve-stem 20.

The piston-disk 6 opposite the piston-ways or steam-spaces 7 8 is provided with a transverse passage 39, in which is located a vibrating piston 40, whose length or axial diameter is equal to the distance between the outer walls of the steam-spaces or piston-ways 7 8, while its width or diameter, extending transversely of the axis of the engine, is equal to the distance between the circumferential walls of such steam-spaces or piston-ways, so that one end of the piston will always protrude a sufficient distance from each face of the piston 6 to completely project across or through each of the steam-spaces or piston-ways 7 8 at the point where the piston is situated, and the piston will alternately vibrate into the ways 7 8 by virtue of the diagonal relation of the piston 6 to the interior of the casing. This piston 40 might of course be made to slide back and forth between suitable packings arranged in the passage 39 in the piston-disk 6 and to be governed in its

movement solely by the outer walls of the piston-ways 7 8, the shallow portion of one way pushing the piston endwise into the deep portion of the other way; but such construction would be undesirable in view of the great friction that would result from moving the piston while under pressure, and in order that this friction may be overcome and the piston balanced and made free to move back and forth in the opening 39 regardless of the steam-pressure on opposite sides of the piston-disk I hinge the piston in such a manner that it will reciprocate or vibrate in the opening 39 in an approximately straight line as contradistinguished from swinging bodily upon an arc of a circle. I attain this end by means of a pair of pivoted arms 41 42, the former of which is pivoted at 43 in a recess 44, formed in one face of the piston-disk 6, while the other, 42, is pivoted at 45 in a similar recess 46 in the opposite face of the piston-disk. These arms 41 42 are pivoted at their other ends to opposite sides and opposite ends of the piston 40 by means of pivot-lugs 47 or other suitable devices, so that when the piston vibrates in the opening 39 the arms will describe arcs in opposite directions. For instance, assuming the parts to be in the position shown in Fig. 2 and the piston-disk revolving to the left, the arm 41, as the piston 40 moves toward it, will describe a right curve and tend to pull the upper end or right-hand end of the piston 40 toward the pivot 43, while the arm 42 will describe a left curve, and in doing so will also push the opposite end of the piston to the left or toward the pivot 43, and consequently counteract the oscillatory or independent rotary movement of the piston 40, resulting from its tendency to follow the arc described by the pivot 47. The arms 41 42 are also arranged out of parallelism and substantially in the relation shown in Fig. 2, so that the pressure of the steam against the right-hand face of the piston in the steamway 8 will tend to straighten the arm 42 into parallelism with the plane of rotation of the disk 6, and hence force the piston 40 through the passage 39 and cause it to protrude into the gradually-widening steamway 7 on the opposite side, and when the piston has completed its movement in that direction the arm 41 will bear the same relation to the opposite face of the disk 6 that the arm 42 now bears to the left-hand face of the disk 6. Another object of this arrangement is to enable me to effectually pack the piston 40 in the passage 39 in the piston-disk 6. When the piston reciprocates back and forth through the disk, it will be seen that each face thereof opposite the pivots 47 describes a curve which is a compound of the two arcs described by the pivots 47. Each face of the piston therefore is cut away on this curve, as clearly shown in Fig. 2, whereby a packing-bar 48 may be so arranged in grooves 49, formed in the vertical walls of the passage 39, as to bear with approximately uniform pressure against these curved surfaces, and thus prevent the steam from escaping from one of the piston-ways 7 8 between the perpendicular walls of the passage 39 and the perpendicular faces of the piston 40. Steam is prevented from escaping over the upper and lower edges of the piston 40 by means of packing-bars 52, set in suitable grooves in the upper and lower edges of the piston and bearing against the top and bottom of the passage 39, and each having its edge adjacent to the bars 48 curved parallel with the curved face of the piston and bearing against the bars 48. The ends of the piston 40 are provided with packing-bars 51, which bear against the outer walls of the piston-ways 7 8, respectively.

With the engine thus constructed it will be seen that while one end of the piston 40 is receiving pressure through the port 13, (see Fig. 2,) impelling the piston 40 to the left, the opposite end but same face of the piston is also receiving pressure through the port 14^a at the lower side of the casing.

55 56 represent packing-rings seated in opposite walls of the casing 1 and 2 and bearing against the opposite faces of the piston-disk 6 to prevent the passage of steam to the shaft 5.

In Fig. 6 I have shown the application of my improvements to a compound engine, which consists simply in duplicating the steam-space or piston-ways, so as to form two piston-ways 57 58, surrounding and concentric with the piston-ways 7 8, and extending the piston-disk 6, so as to carry an additional piston 59, whose ends engage, respectively, in the piston-ways 57 58, such piston 59 being similar in construction and arrangement to the piston 40, already described, and it being also provided with the oscillating arms and necessary packing-bars similar to those described with reference to the piston 40. This engine is designed to utilize high-pressure steam in the inner or smaller piston-ways and the exhaust in the larger or outer piston-ways 57 58, and in order to do this any suitable passages and systems of valves may be utilized for catching the steam as it exhausts through the exhaust-port 24 of the high-pressure engine and carrying it to the inlet-port 60 of the low-pressure engine. In the form I have shown the exhaust-port 24 extends through the top of that portion of the valve-casing which houses the valve 19 instead of through the bottom of such casing, as in Fig. 1. This exhaust-port 24 communicates by passage 61 with the inlet-passage 60 of the low-pressure engine, which leads into a valve-casing 62, having a valve 63 (similar in construction and arrangement to the valve 19) guarding two ports opening into the steam-space 58 of the low-pressure engine, one of such ports being arranged on either side of the packing-blocks 64, which is similar in arrangement and construction to the packing-blocks 12 12^a already described. The exhaust-port 65 of the low-

pressure engine leads to a duct or channel 66, (shown in dotted lines,) which communicates with a common exhaust-pipe 67. This exhaust-pipe is also in communication via passage 68 with the exhaust-port 24, but which passage 68 is closed by means of a cock 69 when low-pressure steam is used in the low-pressure engine; but when it is desired to use high-pressure steam in both engines the cock 69, which is a two-way cock, is turned to place the exhaust-port 24 in communication with the passage 68, whereupon the exhaust from both engines will escape directly into the atmosphere through the exhaust-pipe 67. In this event high-pressure steam is admitted to the larger engine through a branch pipe 70, which is ordinarily closed by a cock 71 when the engine is being utilized as a high and low pressure engine. This valve mechanism and system of passages are duplicated on the opposite side of the casing and diametrically opposite with reference to the circumference of the piston-disk, and the low-pressure engine operates in the manner before described with reference to the high-pressure engine in Figs. 1 and 2. The valves 19 and 63 are preferably secured to the same valve-stem 72, so as to operate in unison, and in order that the upper set of valves may be coupled with and operate in unison with the lower set of valves the upper valve-stem 72 is provided with a crank-arm 73 and the lower set with a crank-arm 74, the two crank-arms being connected together by the rods 75, crank-arm 76, shaft 77, crank-arms 78, and link 79, all similar in construction and operation to the corresponding mechanism described with reference to the valves 19 26 in Figs. 1 and 2.

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

1. A rotary engine having in combination a casing provided with an annular steam-space, a rotary piston-disk dividing said space diagonally into two piston-ways or steam-spaces gradually widening from a point of contact with said disk, said disk being provided with a recess or opening, a piston protruding from each side of said disk and engaging in said piston-ways and hinged arms pivoted to said piston, substantially as set forth.

2. A rotary engine having in combination a casing provided with an annular steam-space, a rotary piston-disk dividing said space diagonally into two piston-ways gradually widening in both directions from a point of contact with said disk, a vibrating piston carried by said disk and projecting into both of said piston-ways, and non-parallel arms pivoted to opposite sides of said piston and to said disk, substantially as set forth.

3. A rotary engine having in combination a casing provided with an annular steam-space, a rotary piston-disk dividing said space into two piston-ways diverging from a point of contact with said disk, said disk being provided with a passage therethrough, a piston located in said passage and projecting into both of said piston-ways, a pivoted arm pivoted to each end and opposite sides of said piston, and a packing-bar carried by said disk and bearing upon each side of said piston at substantially opposite ends thereof, substantially as set forth.

ITHUEL M. JOHNSON.

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