No. 854,783. PATENTED MAY 28, 1907.

G. VOITH.

ROTARY ENGINE.

APPLICATION FILED DEC. 28, 1906.

4 SHEETS—SHEET 1.

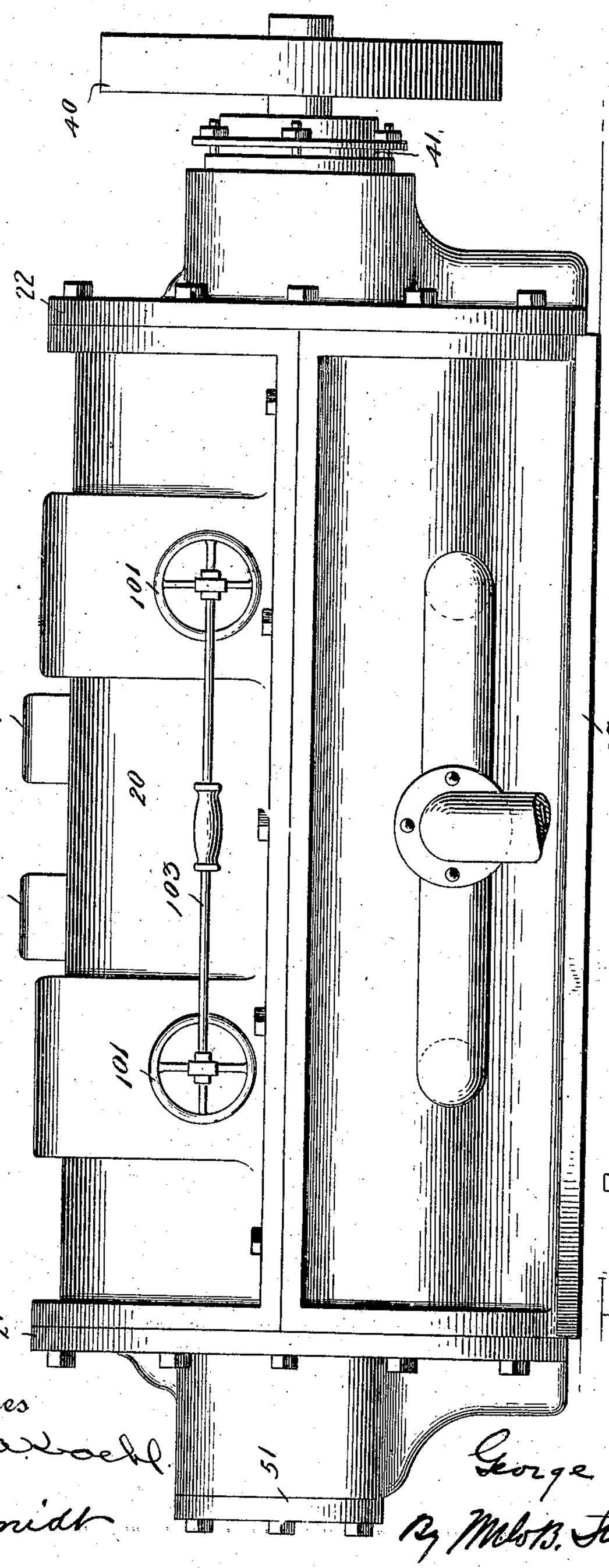

FIG. 1.

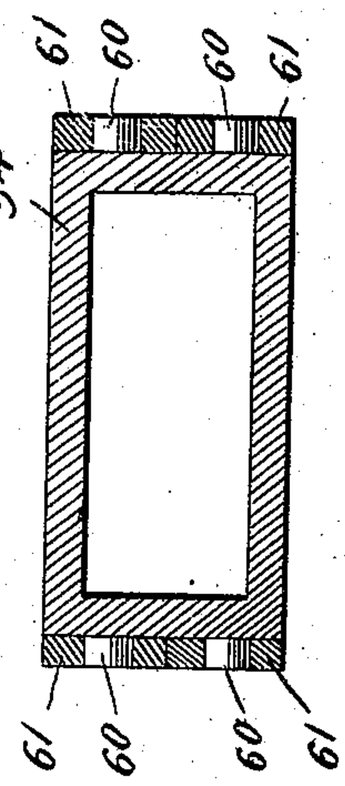

FIG. 2.

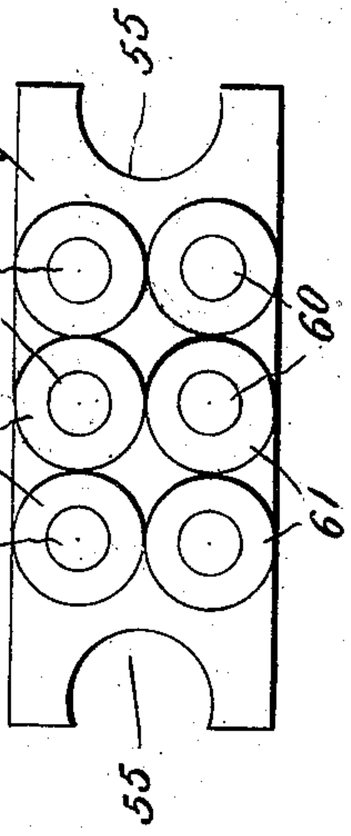

FIG. 3.

Witnesses

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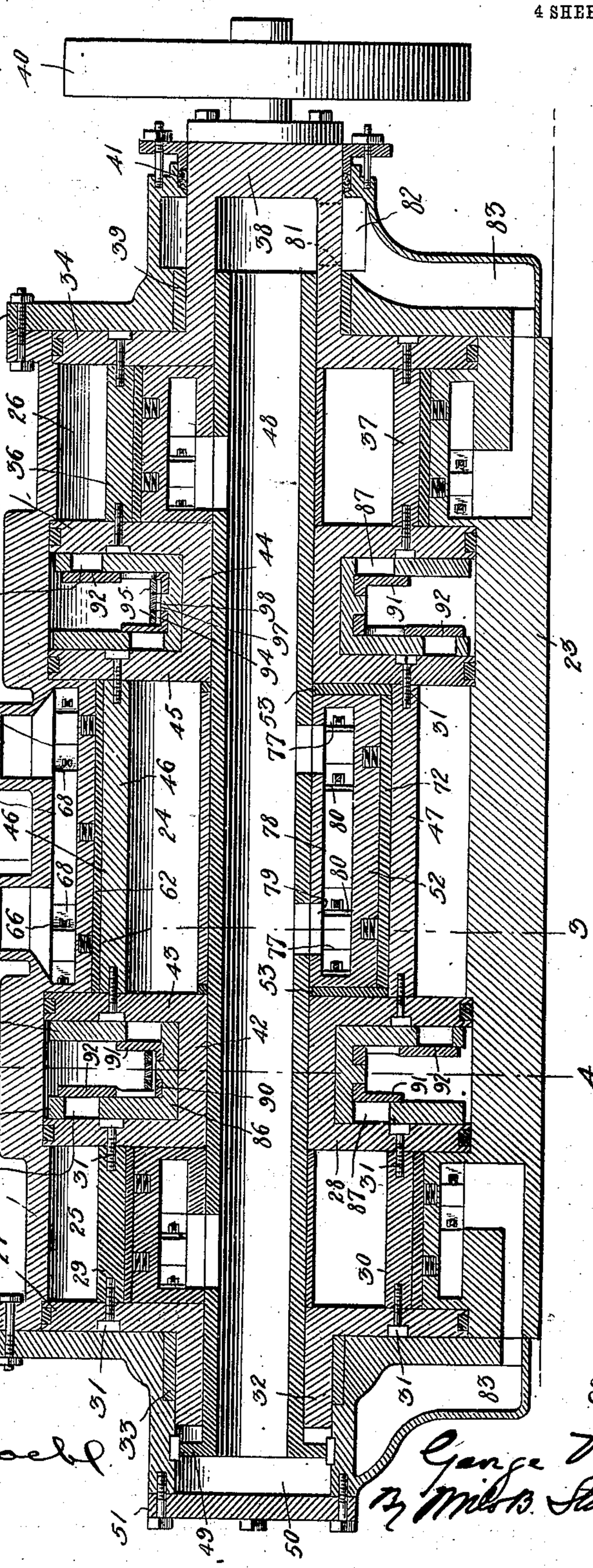
4 SHEETS—SHEET 2.

FIG 2.



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4 SHEETS—SHEET 3.

FIG. 3.

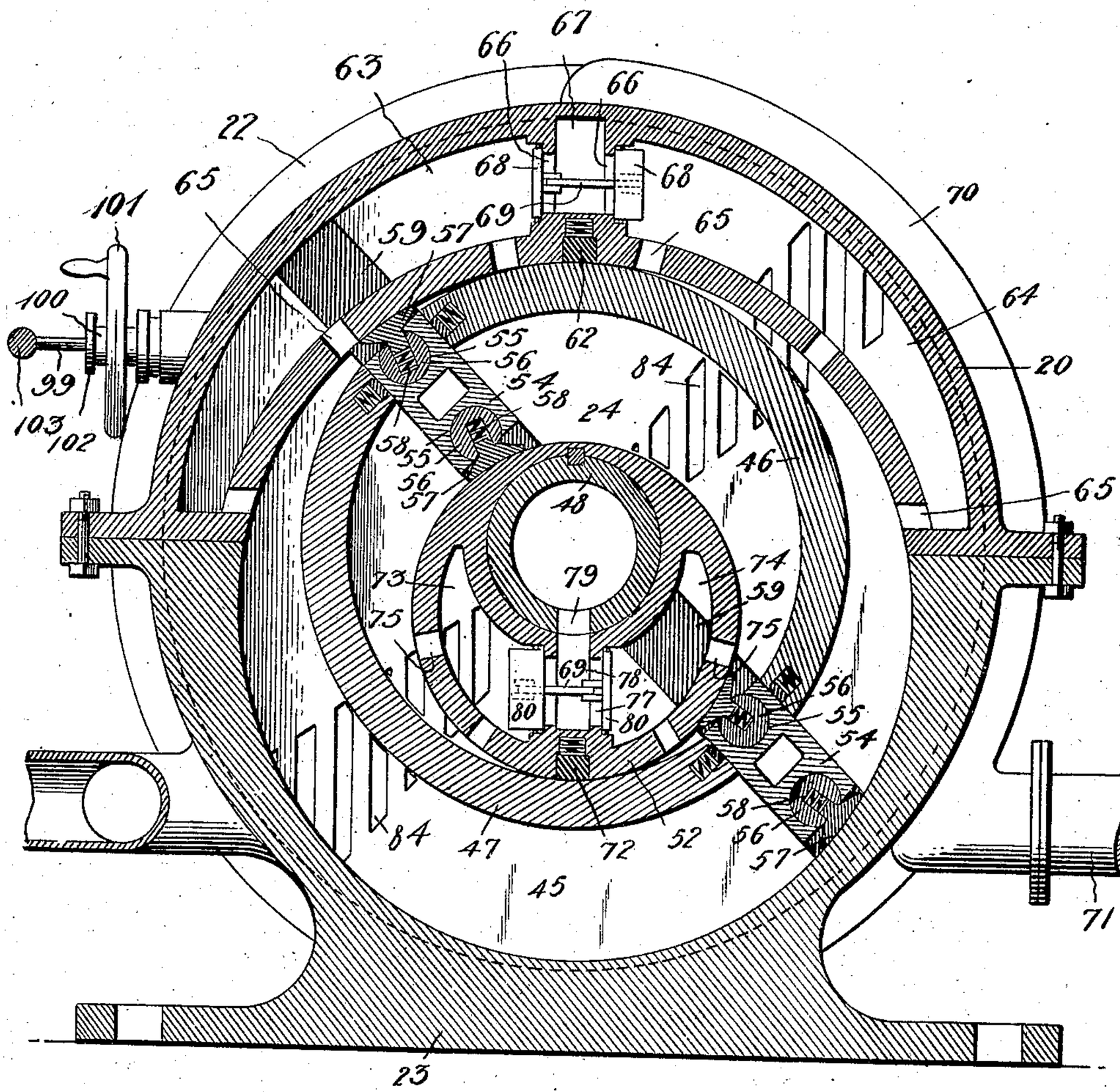

FIG. 10.

Witnesses

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ROTARY ENGINE.

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4 SHEETS—SHEET 4.

Fig. 4.

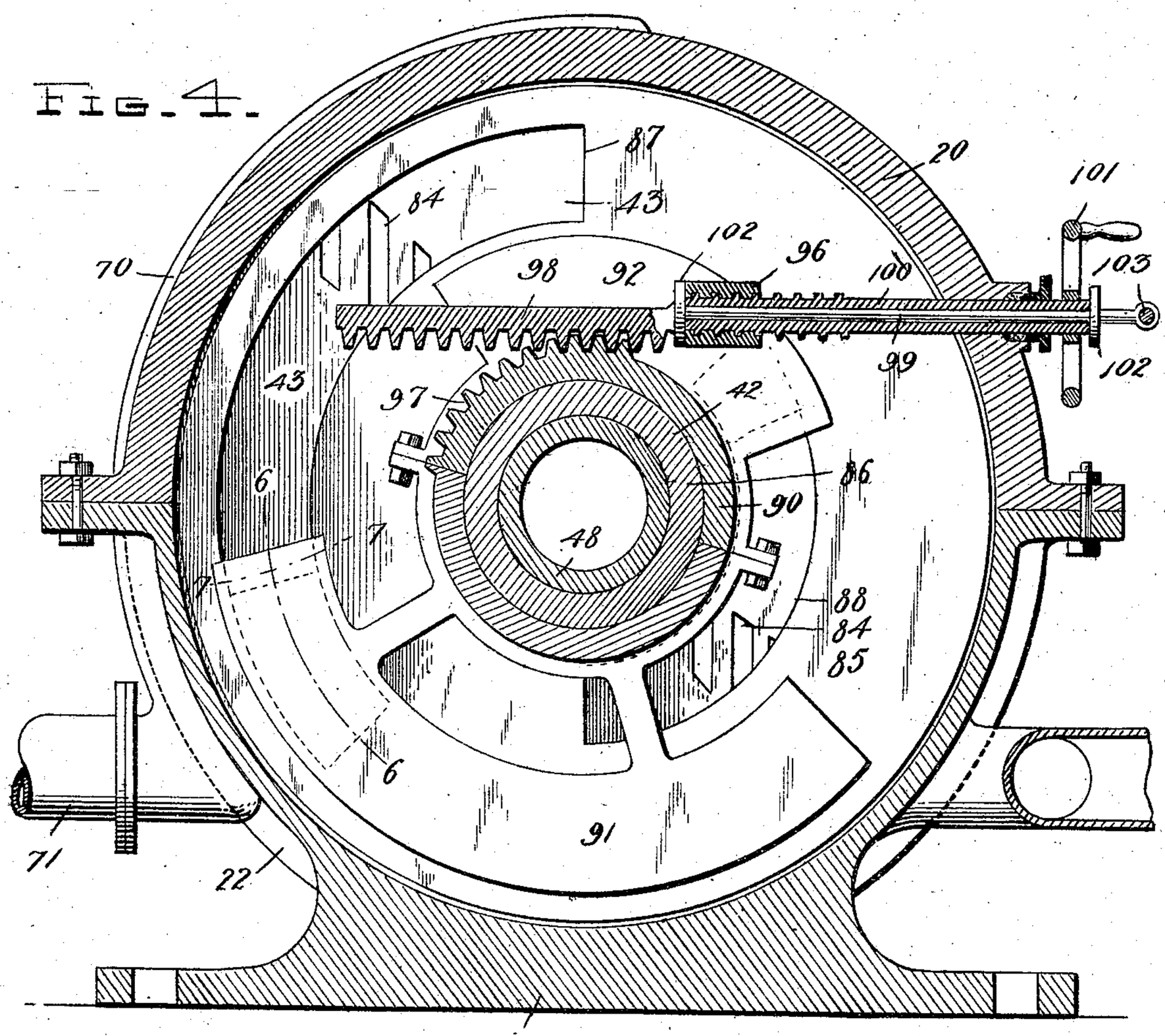


Fig. 6.

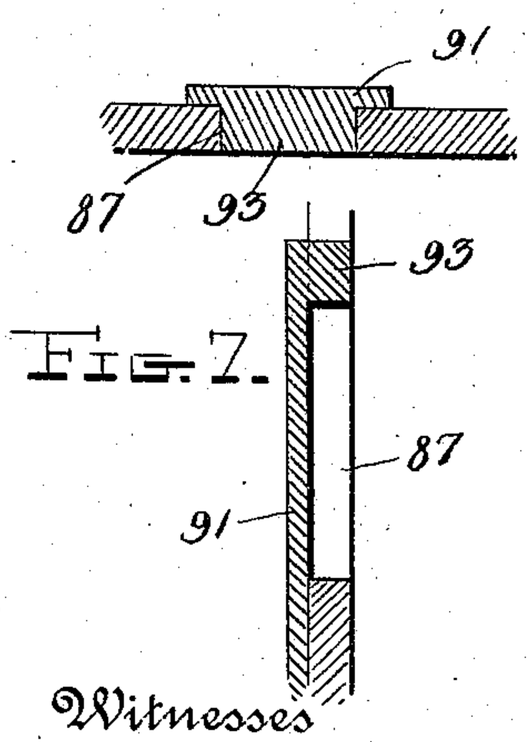
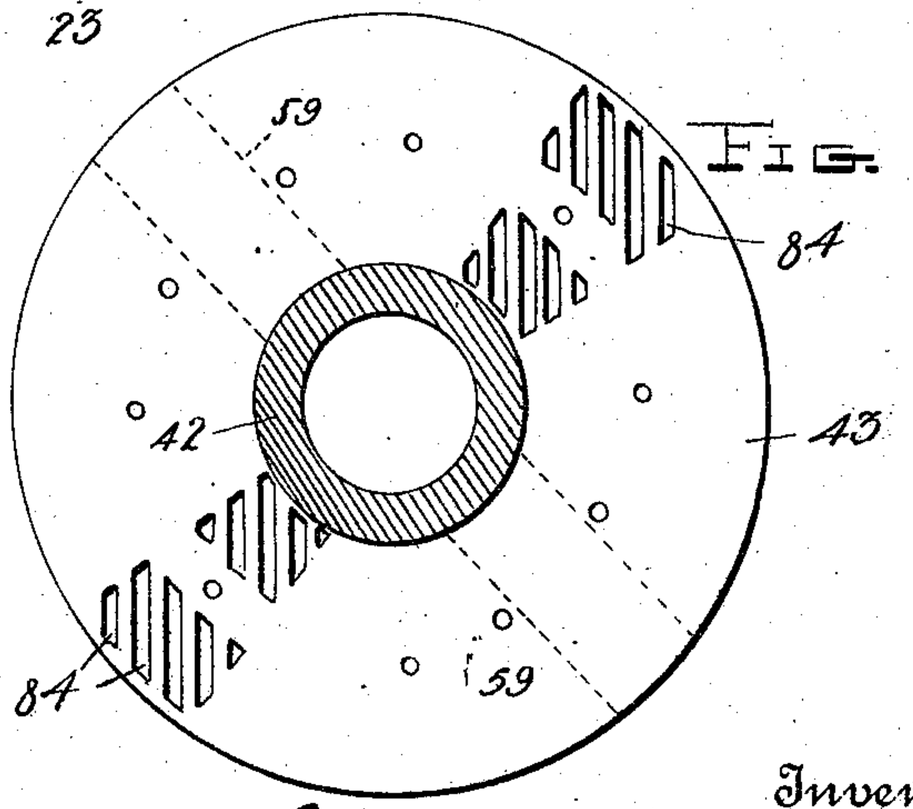


Fig. 7.

Fig. 5.



Witnesses

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UNITED STATES PATENT OFFICE.

GEORGE VOITH, OF BALTIMORE, MARYLAND.

ROTARY ENGINE.

No. 854,783. Specification of Letters Patent. Patented May 28, 1907.

Application filed December 28, 1906. Serial No. 349,807.

To all whom it may concern:

Be it known that I, GEORGE VOITH, a citizen of the United States, residing at Baltimore, and State of Maryland, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention is a rotary engine, and more particularly that kind in which the motive fluid acts on a cam-actuated sliding piston.

The object of the invention is to provide a plurality of working chambers which are arranged with a view to properly balancing the engine, in order that it may be run at great speed without jarring or pounding.

A further object is to provide an improved cut-off and reversing gear, together with other novel features of construction to be hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a front elevation of the engine. Fig. 2 is a horizontal section. Fig. 3 is a vertical section on the line 3—3 of Fig. 2. Fig. 4 is a vertical section on the line 4—4 of Fig. 2. Fig. 5 is an end view of one of the drums hereinafter referred to. Figs. 6 and 7 are sectional details on the lines 6—6 and 7—7, respectively, of Fig. 4. Figs. 8 and 9 are details of the piston. Fig. 10 is a bottom plan view of the mechanism for operating the cut-off and reversing gears.

Referring specifically to the drawings, 20 denotes a horizontally disposed cylinder closed at its ends by cylinder-heads 21 and 22, respectively, and having a base 23. The cylinder is divided into a plurality of working chambers, three being shown, indicated at 24, 25 and 26, respectively. The chamber 24 is located in the middle of the cylinder 20, and the ones 25 and 26 at the ends thereof. The area of each end chamber is one-half the area of the middle chamber so that the engine will be properly balanced.

In the end chamber 25 are located disks 27 and 28, respectively, which are connected by a cylinder, thus forming a drum. The cylinder is in two sections indicated at 29 and 30, respectively, and these sections are secured to the disks at a distance from their peripheries by counter-sunk bolts 31 with a space between the ends of the sections for a purpose to be hereinafter described. The disk 27 fits against the cylinder-head 21, and has a hub 32 which is supported in a brass-lined bearing 33 in said cylinder-head. The end chamber 26 also contains a drum which is formed by disks 34 and 35, respectively, connected by cylinder-sections 36 and 37 in the same manner as the disks 27 and 28. The drum thus formed is of the same size as the drum in the working chamber 25. The hub 38 of the disk 34 is supported in a brass-lined bearing 39 formed in the cylinder-head 22, and also extends outside thereof, being fitted with a belt-pulley 40. The opening in the cylinder-head 22 through which the hub 38 passes is provided with a stuffing-box 41.

The disk 28 has a hub 42 on which is a disk 43, and the disk 35 has a hub 44 on which is a disk 45. These disks are connected by cylinder-sections 46 and 47, respectively, to form the drum of the working-chamber 24. The connection between the disks 43 and 45 and its cylinder-sections is made in the same manner as the parts constituting the drums in the working-chambers 25 and 26. The hubs 32, 42, 44 and 38 have axially alined openings to receive a hollow shaft 48 one end of which projects from the hub 32 and has a flange 49 whereby it is fastened in an opening 50 in the cylinder-head 21. This opening is closed by a cap 51. The end of the hub 38 which carries the belt-pulley 40 is closed.

To the hollow shaft 48, between the disks 43 and 45 is keyed a drum 52 with a suitable packing 53 between the ends of the drum and the disks to make a steam-tight joint between said parts. The drum is eccentrically mounted on the shaft 48 thus forming a cam for actuating the sliding pistons 54 of which there are two. The pistons are diametrically opposite each other and are mounted between the ends of the cylinder-sections 46 and 47, a suitable packing being provided. The ends of the piston have sockets 55 which receive a cylindrical block 56 having a longitudinal recess containing a sliding packing block 57 which is pressed outwardly by springs 58 located in the recess behind the packing block. The disks 43 and 45 have guide-grooves 59 in which the sides of the pistons work and said sides have projecting studs 60 on which anti-friction rollers 61 are mounted. For the sake of lightness the pistons will be made hollow as shown. The inside of the cylinder 20 between the disks 43 and 45 is concentric with respect to the periphery of the drum 52, and the sections 46 and 47 are concentric to the shaft 48, by reason of which the ends of

the pistons are held in sliding contact with the wall of the cylinder 20 and the periphery of the drum 52, respectively, when the disks 43 and 45 and the sections 46 and 47 rotate. The packing block 57 makes a steam-tight joint without undue friction, the ends of the blocks being rounded to insure them always having a proper bearing.

The periphery of the cylinder-sections 46 and 47 are in contact with the wall of the cylinder 20 at one place, and at the point of contact is located a spring-pressed packing strip 62. The cylinder 20 adjacent this point is enlarged, and in said enlarged portion, on opposite sides of the point of contact, are exhaust passages 63 and 64, respectively, which communicate by ports 65 with the steam space between the wall of the cylinder 20 and the sections 46 and 47. The exhaust passages also communicate by ports 66 with a longitudinal passage 67. The ports 66 are fitted with gates 68 connected by links 69 or other suitable means in such a manner that when the gates controlling the exhaust passage 64 are opened, the gates controlling the exhaust passage 63 will be closed, and vice versa. The passage 67 connects with the branches 70 of the exhaust pipe 71.

At a point diametrically opposite the point of contact between the wall of the cylinder 20 and the sections 46 and 47, the periphery of the drum 52 contacts with the inside of said sections, a spring-pressed packing strip 72 also being provided. On opposite sides of this point of contact, the drum has exhaust passages 73 and 74, respectively, which communicate by ports 75 with the space between the drum and the sections 46 and 47. The exhaust passages 73 and 74 also communicate by ports 77 with a longitudinal passage 78 which in turn communicates by ports 79 with the hollow shaft 48. The ports 77 are fitted with gates 80 which are connected and operate in the same manner as the gates 68. The exhaust from the hollow shaft passes into the opening 50 of the cylinder-head 21, and at the other end of the shaft through openings 81 in the hub 38 into an opening 82 in the cylinder-head 22. The openings 50 and 82 are connected by passages 83 with the exhaust-pipe 71.

The parts in the working-chamber 24 herein described are duplicated in the working-chambers 25 and 26, the position of the working parts, however, being located diametrically opposite or reversed in order to secure a proper balance and smooth running of the engine, the balancing effect being augmented by making the area of each end chamber equal to one-half the area of the middle chamber.

Steam enters the working-chamber 24 through ports 84 in the disk 43. These ports comprise a series of oblique openings extending diametrically across the disk midway between or at right angles to the pistons 54. The disk 45 is similarly constructed and steam enters the working-chamber 24 therethrough also. These inlet ports are controlled by a disk 85 having a hub 86 whereby it is mounted on the hub 42. The disk 85 fits closely against the disk 43 and has openings 87 and 88, respectively, located at different distances from the center of the disk. The opening nearest the center is to admit steam behind the pistons in the space between the drum 52 and the cylinder-sections 46 and 47, and the other opening admits steam behind the pistons in the space on the outside of said sections. The closed portion of the disk 85 covers such of the openings 84 which are in front of the pistons. The hub 86 also has a disk 89 similar to the disk 85 to control the openings in the disk 28.

A cut-off gear is also provided to enable the steam to be used expansively. This gear comprises a hub 90 mounted on the hub 86, and carrying segmental plates 91 and 92, respectively, which are adapted to cover and uncover more or less the openings 87 and 88. There are two of these reversing gears on the hub 86, one being for the disk 85, and the other for the disk 89. The plates 91 and 92 are formed with projections 93 which fit closely in the openings 87 and 88 and bear against the disks 28 and 43 so as to block the passage of steam beyond that point. The variation in the cut-off is readily effected by rotating the plates 91 and 92 so as to cover or uncover the openings 87 and 88 more or less.

The hubs 90 of the reversing gears are formed with gear teeth 94 which mesh with rack-bars 95 extending from a block 96. The hub 86 between the gear teeth 94 is also formed with gear teeth 97 which mesh with a rack-bar 98 carried by a stem 99. Into the block 96 is threaded a hollow screw-shaft 100 which extends outside the cylinder 20 and is fitted with a hand-wheel 101. The stem 99 extends through the shaft 100 and has collars 102 between which the shaft is confined on the stem. The cut-off is adjusted by turning the hand-wheel which turns the screw-shaft and through the rack-bars 95 and gears 94 shifts the plates 91 and 92. The engine is reversed by moving the stem in either direction, which, through the rack-bar 98 and gear 97, shifts the disks 85 and 89. When the shaft 100 is turned for adjusting the cut-off, the rack-bars 95 move independent of the rack-bar 98, but when the stem 99 is moved in either direction for operating the reverse, the screw-shaft 100 by reason of the collars 102 moves with it, so that there will be no relative movement of the cut-off plates and the disks 85 and 89, thus leaving the cut-off as it was before the engine was reversed. The entry of steam to the working-chamber 24 through the disk 45 and to the working-

chamber 26 through the disk 35 is controlled by a cut-off and reversing mechanism which is a duplicate of the one already described. The stems 99 of the two reversing gears are provided with a suitable connection 103 so that they may be operated simultaneously.

The operation of the engine will probably be best understood by an inspection of Fig. 3. The engine is supposed to be running from right to left. Steam enters the working-chamber 24 through the ports 84 when said ports register with the openings 87 and 88 in the disks 85 as already described, and its pressure against the pistons causes rotation of the drum formed by the disks 43 and 45 and the sections 46 and 47. As soon as the ports 84 and the openings 87 and 88 cease to register, the steam begins to act expansively, the time at which expansion commences being capable of variation by the cut-off gear already described. The gates 68 of the exhaust passage 64 are open, as well as the gates of the exhaust passage 73. The exhaust from the space between the sections 46 and 47 and the cylinder 20 is through the exhaust passage 64 by the ports 65. The exhaust from the space inside the sections 46 and 47 is through the ports 75, passage 73, ports 80, passage 78 and through ports 79 into the hollow shaft 48. The gates of the exhaust passages 63 and 74 are held closed by the steam pressure which enters through the ports 65 and 75. When the engine is reversed the position of the gates is automatically reversed by the steam pressure against the open gates which are then blown closed, while the opposite gates to which they are connected are thereby opened, thus opening the passages 63 and 74 to the exhaust and closing the passages 64 and 73 thereto.

The ports 65 and 75 serve to prevent back pressure against the piston. This is clearly illustrated in Fig. 3 in which it will be seen that steam is on both sides of the outer end of the upper piston, and on both sides of the inner end of the lower piston. The ports 65 will be located quite close to the point of contact of the sections 46 and 47 with cylinder wall 20, so the steam can get behind the piston as soon as it passes this point. The slight inequality of pressure against this end of the piston due to the difference of its areas on opposite sides is negligible in view of the large area the lower piston offers to the steam pressure. This is also true with respect to the piston ends which work inside the sections 46 and 47, the ports 75 also being close to the point of contact of the drum 52 with said sections.

The parts in the working-chambers 25 and 26 operate in the same manner as those in the chamber 24, the location of such parts however being reversed. In the chambers 25 and 26 the eccentricity of the drums 52 and the position of the exhausts is diametrically opposite the position of these parts in the chamber 24, by reason of which the position and working of the pistons in the chambers 25 and 26 is reverse to that of the pistons in the chamber 24. This arrangement, together with the fact that the combined area of the working chambers 25 and 26 is equal to the area of the chamber 24, makes a perfectly balanced engine which can be run at great speed without jarring or pounding.

I claim:—

1. In a rotary engine, a cylinder; a fixed shaft therein; a drum in the cylinder concentric to the shaft; a stationary cam on the shaft inside the drum; radial pistons passing through the drum, and having their opposite ends in sliding contact with the cylinder wall and the periphery of the cam, respectively; inlet ports in the heads of the drums; and exhaust ports from the spaces inside and outside the drum.

2. In a rotary engine, a cylinder having exhaust ports; a fixed hollow shaft in the cylinder; a drum inside the cylinder concentric to the shaft, and having steam inlet ports in its heads; a stationary cam on the shaft inside the drum, and having exhaust openings communicating with the ports of the shaft; and radial pistons passing through the drum, and having their opposite ends in sliding contact with the cylinder wall and the periphery of the cam, respectively.

3. In a rotary engine, a cylinder; a fixed hollow shaft therein; a drum in the cylinder concentric to the shaft, and in contact at one point with the cylinder wall; exhaust passages in the cylinder wall on opposite sides of the aforesaid point of contact, and communicating with the space between the drum and the cylinder wall; gates for the outlet of each exhaust passage; inlet ports in the heads of the drums; a stationary cam on the shaft inside the drum, and in contact therewith at one point; exhaust passages in the cam on opposite sides of its point of contact with the drum, and communicating with the inside of said drum; ports from the last mentioned exhaust passages to the hollow shaft; gates for the outlets of said exhaust passages; and radial pistons passing through the drum, and having their opposite ends in sliding contact with the cylinder wall and the periphery of the drum, respectively.

4. In a rotary engine, a cylinder; a fixed hollow shaft therein; a drum in the cylinder concentric to the shaft, and in contact at one point with the cylinder wall; exhaust passages in the cylinder wall on opposite sides of the aforesaid point of contact, and communicating with the space between the drum and the cylinder wall; an outlet passage common to both exhaust passages; gates between said exhaust and outlet passages; inlet ports in the drum; a stationary cam on the shaft inside the drum; and in contact therewith at

one point; exhaust passages in the cam on opposite sides of its point of contact with the drum, and communicating with the inside of said drum; outlet passages to the hollow shaft common to both of the last mentioned exhaust passages; gates between said exhaust and outlet passages; and radial pistons passing through the drum, and having their opposite ends in sliding contact with the cylinder wall and the periphery of the drum, respectively.

5. In a rotary engine, a cylinder; a fixed hollow shaft therein; a drum in the cylinder concentric to the shaft, and in contact at one point with the cylinder wall; exhaust passages in the cylinder wall on opposite sides of the aforesaid point of contact, and communicating with the space between the drum and the cylinder wall; an outlet passage common to both exhaust passages; gates between said exhaust and outlet passages; a connection between said gates for simultaneously opening one and closing the other, and vice versa; inlet ports in the drum; a stationary cam on the shaft inside the drum, and in contact therewith at one point; exhaust passages in the cam on opposite sides of its point of contact with the drum, and communicating with the inside of said drum; outlet passages to the hollow shaft common to both of the last mentioned exhaust passages; gates between said exhaust and outlet passages; a connection between said gates for simultaneously opening one and closing the other, and vice versa; and radial pistons passing through the drum, and having their opposite ends in sliding contact with the cylinder wall and the periphery of the drum, respectively.

6. In a rotary engine, a cylinder; a drum therein; a piston carried by the drum; inlet ports through the head of the drum; a disk on the end of the drum, and having openings adapted to register with the aforesaid inlet ports; and plates on the disks adjustable to cover and uncover more or less the openings therein.

7. In a rotary engine, a cylinder; a plurality of rotating drums therein carrying pistons, and spaced apart; and inlet ports in the adjacent heads of the drums.

8. In a rotary engine, a cylinder; a plurality of rotating drums therein carrying pistons, and spaced apart; inlet ports in the adjacent heads of the drums; and cut-off and reversing gears between the drums.

9. In a rotary engine, a cylinder; a rotating drum therein carrying pistons; inlet ports in the head of the drum; a disk fitting against said drum-head, and having openings registerable with the inlet ports; and a cut-off plate fitting against the aforesaid disk, and adapted to cover and uncover more or less the openings therein.

10. In a rotary engine, a cylinder; a rotating drum therein carrying pistons; inlet ports in the head of the drum; a hub projecting from said drum-head; a reversing disk rotatably mounted on the hub, and having openings registerable with the inlet ports; a cut-off plate fitting against the reversing disk, and adapted to cover and uncover more or less the openings therein; toothed hubs on the reversing disk and cut-off plate; a block having a rack engageable with the toothed hub of the cut-off disk; a hollow screw-shaft threaded through the block; a rack engageable with the toothed hub of the reversing disk, and having a stem extending through the screw-shaft; and stop collars on the stem between which the screw-shaft is confined.

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

GEORGE VOITH.

Witnesses:

C. CHAS. FRIEDEL,

THOS. F. HERR.