No. 708,415. Patented Sept. 2, 1902.

E. L. SILL.

ROTARY ENGINE.

(Application filed Dec. 4, 1901.)

(No Model.) 6 Sheets—Sheet 1.

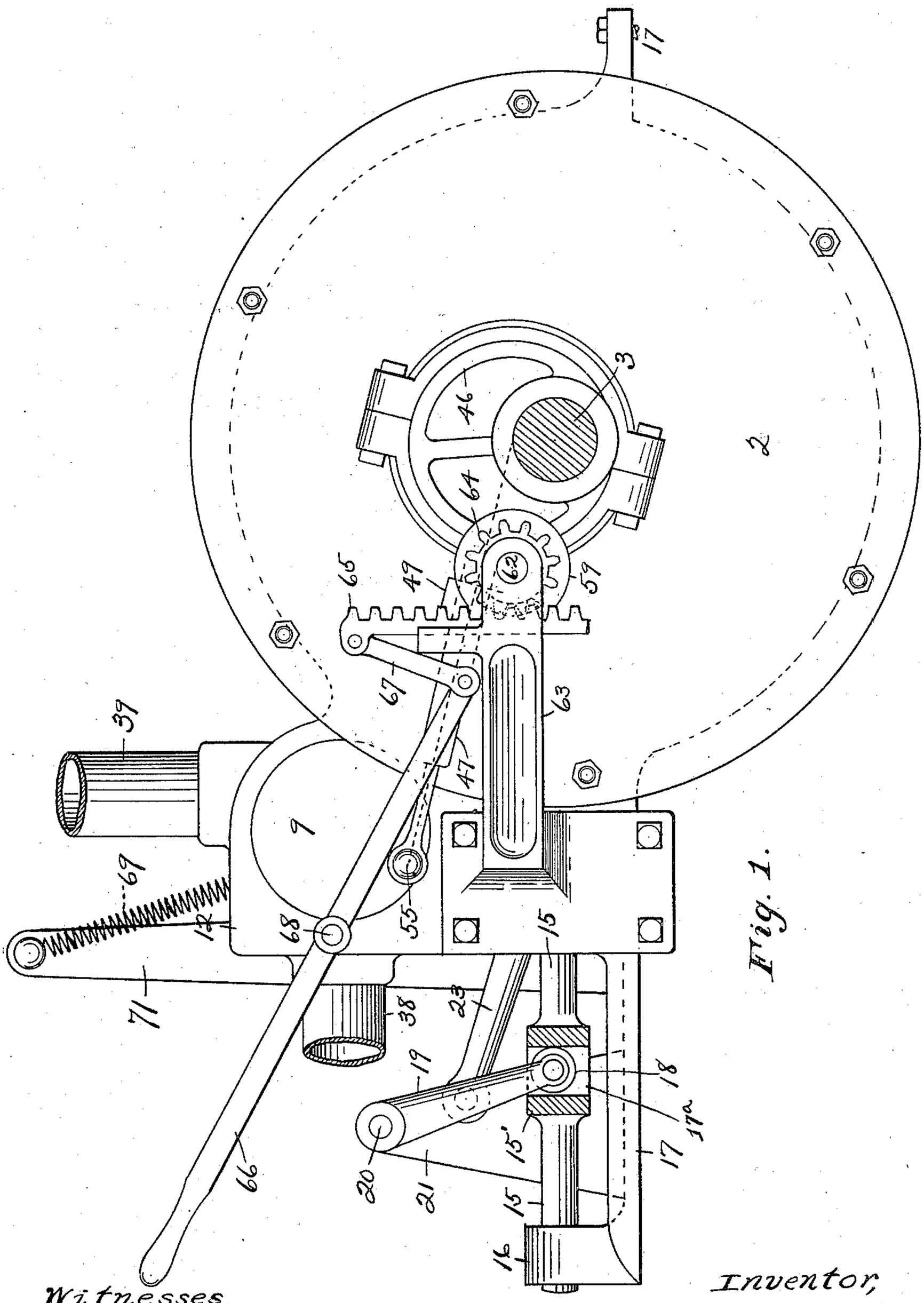

Fig. 1.

Witnesses,
K. M. Imboden,
R. M. Combs

Inventor,
E. L. Sill.

By Higdon & Longan
Att'ys.

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(No Model.) 6 Sheets—Sheet 2.

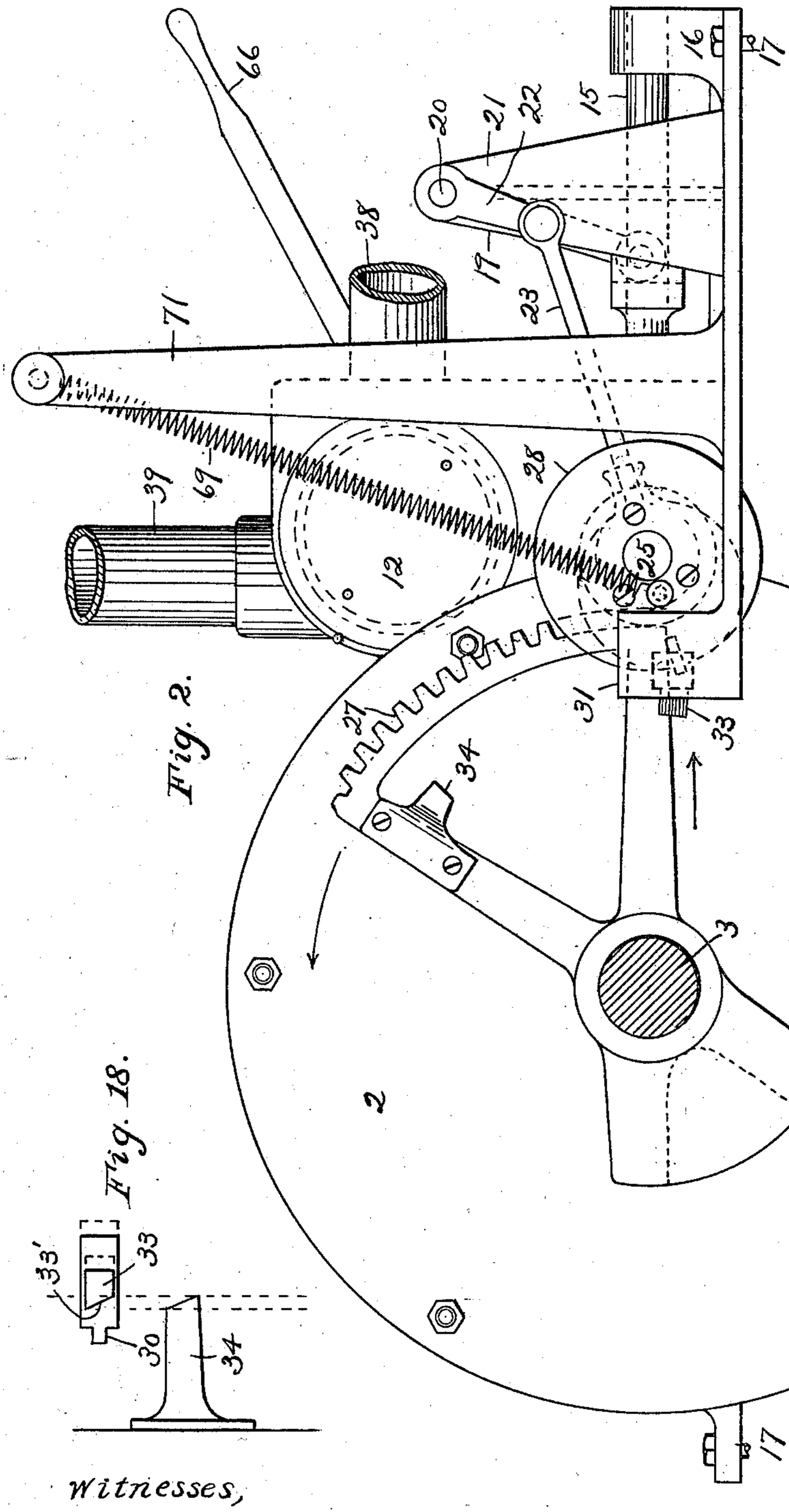

Fig. 2.

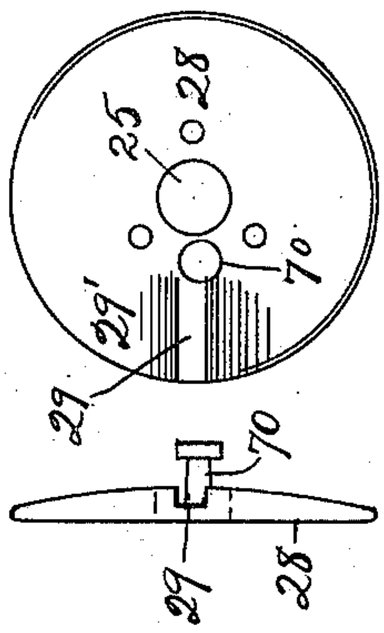

Fig. 17.

Fig. 16.

Fig. 18.

Witnesses,
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Inventor,
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(No Model.) 6 Sheets—Sheet 3.

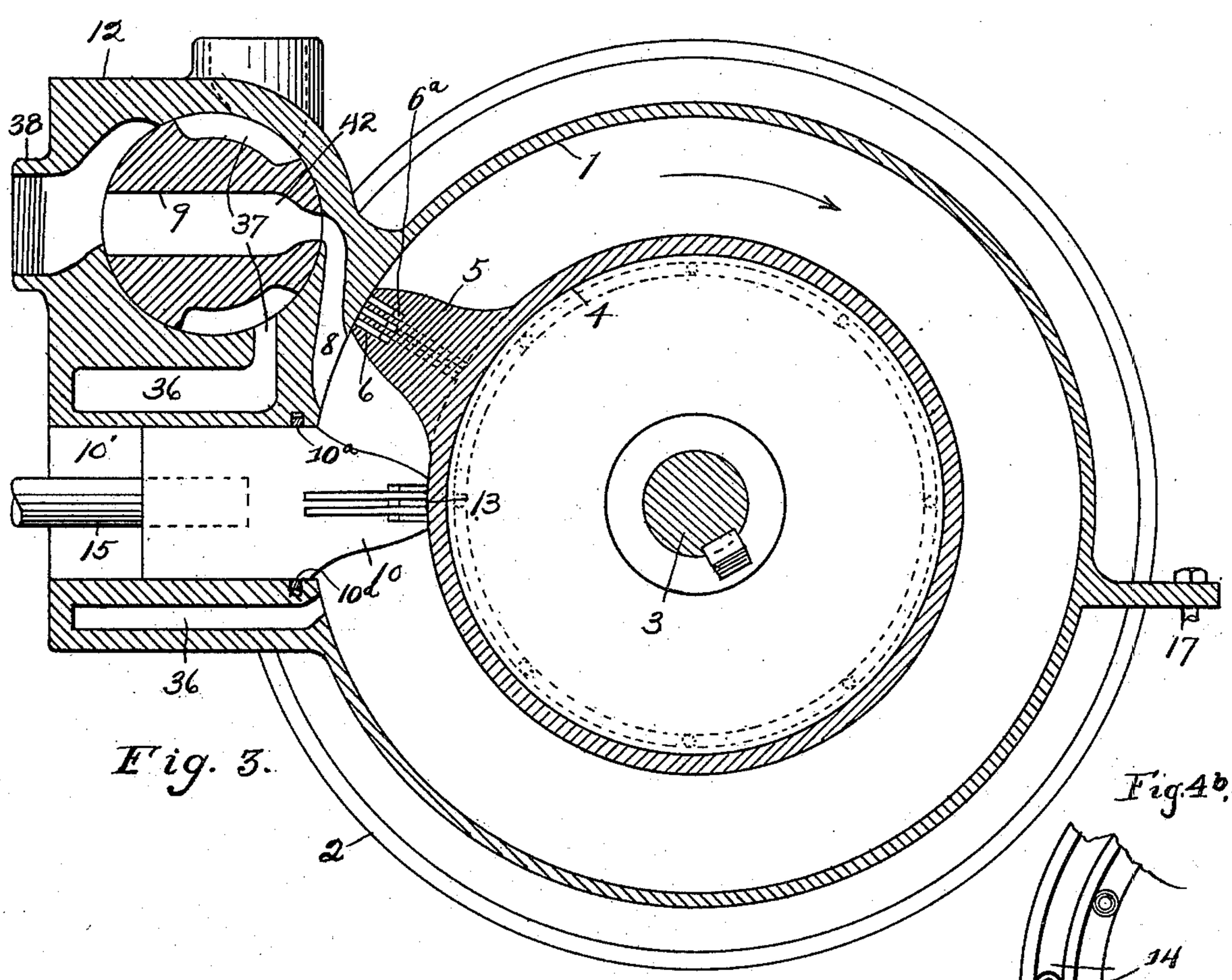

Fig. 3.

Fig. 4b.

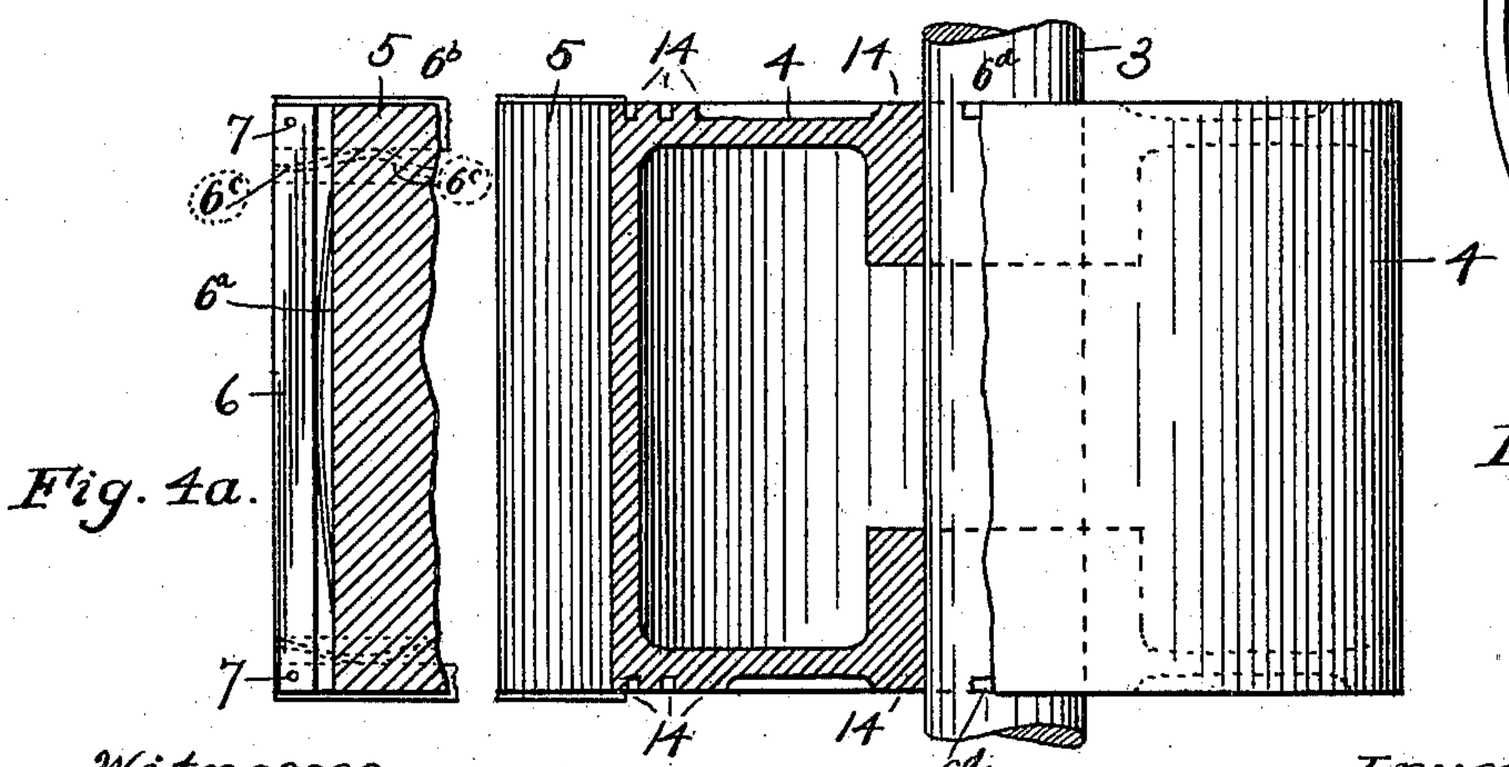

Fig. 4a.

Fig. 4.

Witnesses,
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(No Model.) 6 Sheets—Sheet 4.

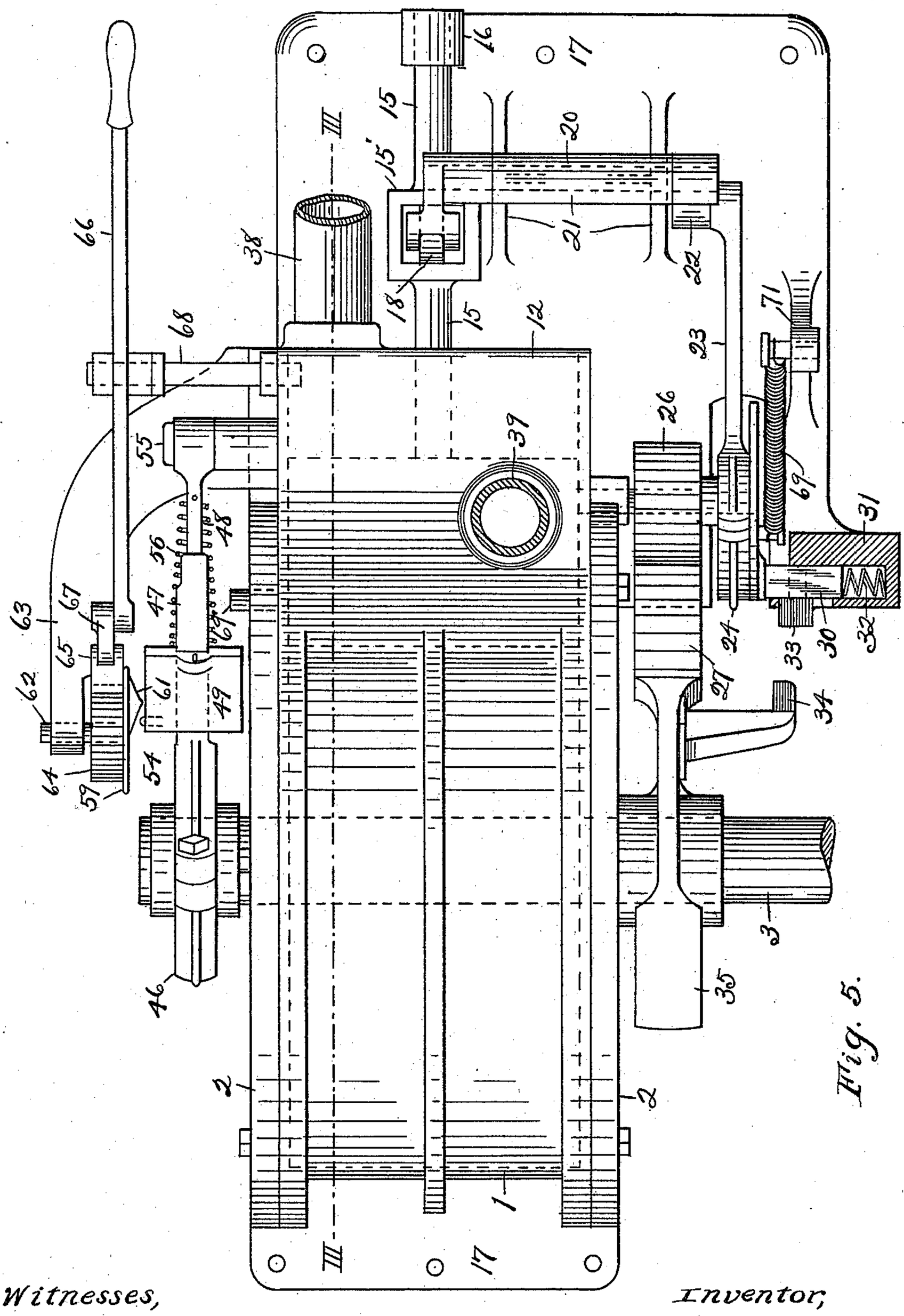

Fig. 5.

Witnesses,
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(No Model.) 6 Sheets—Sheet 5.

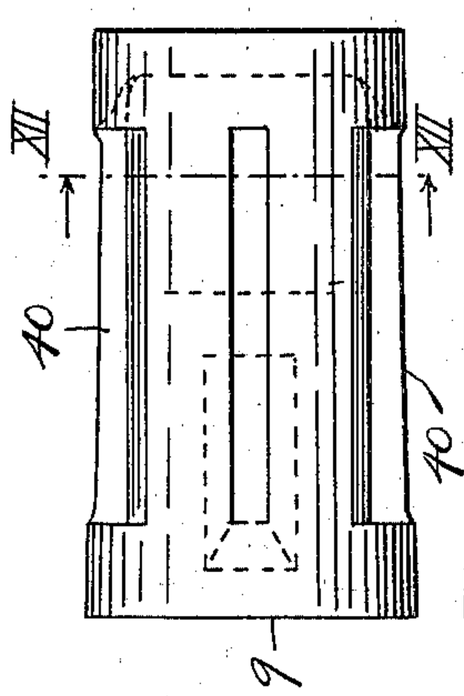

Fig. 9.

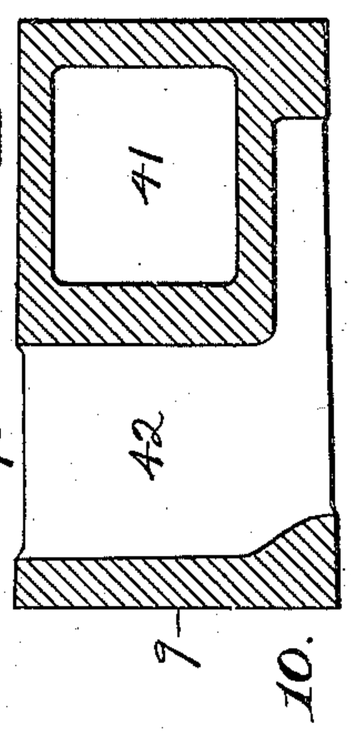

Fig. 10.

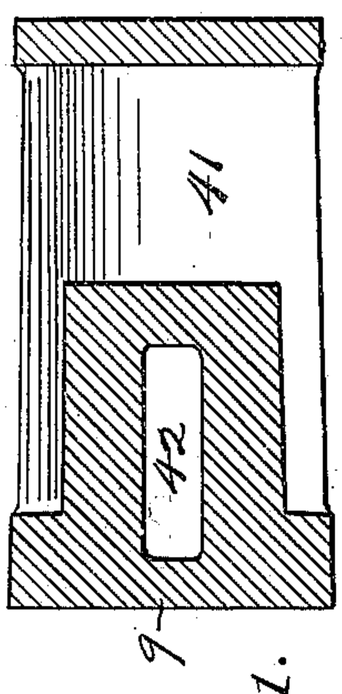

Fig. 11.

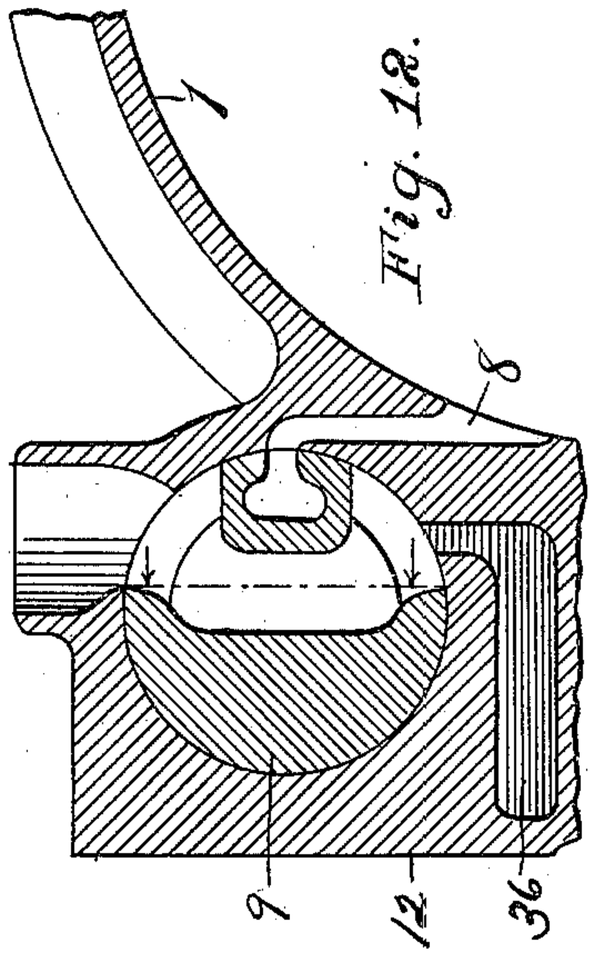

Fig. 12.

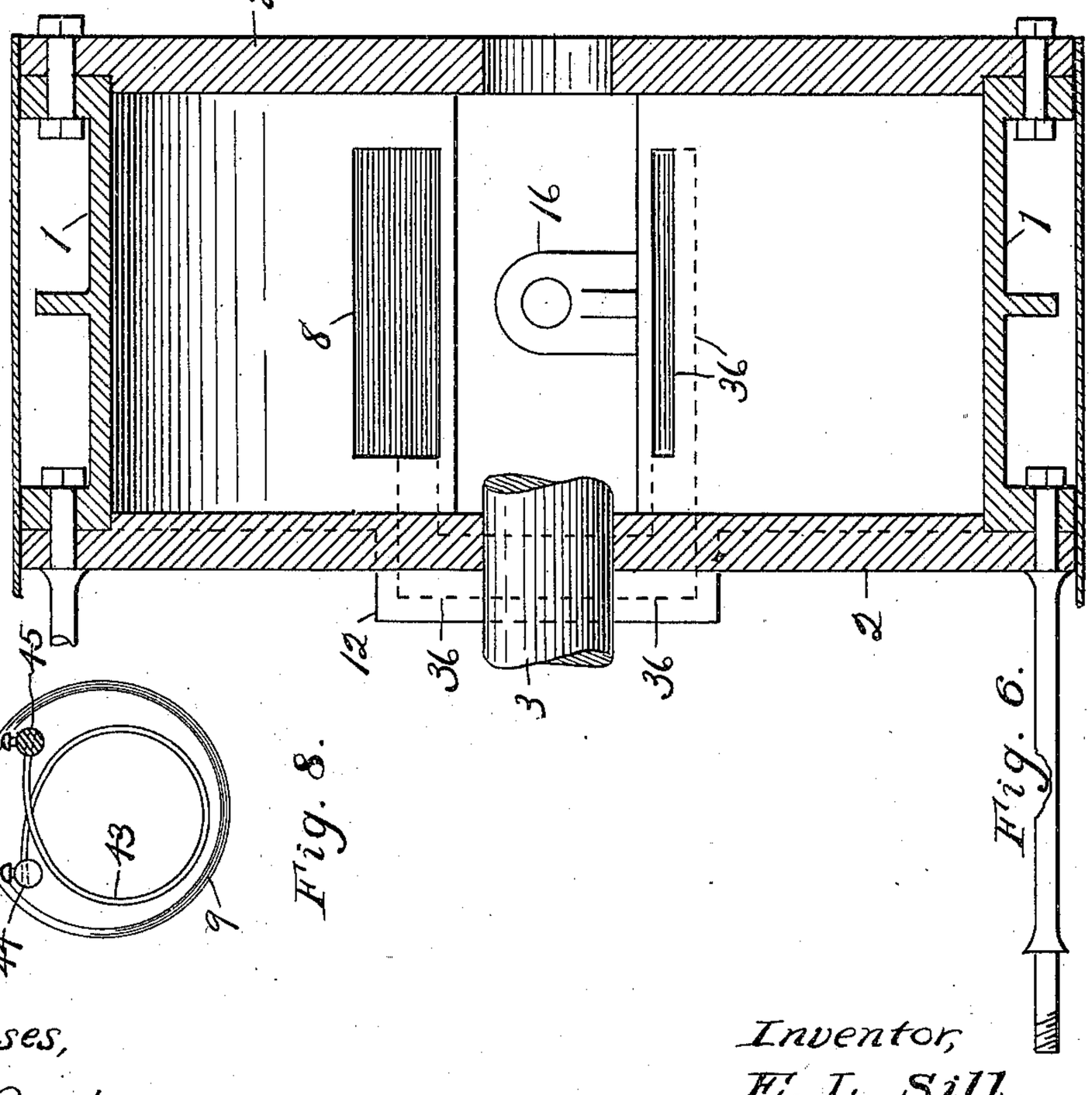

Fig. 6.

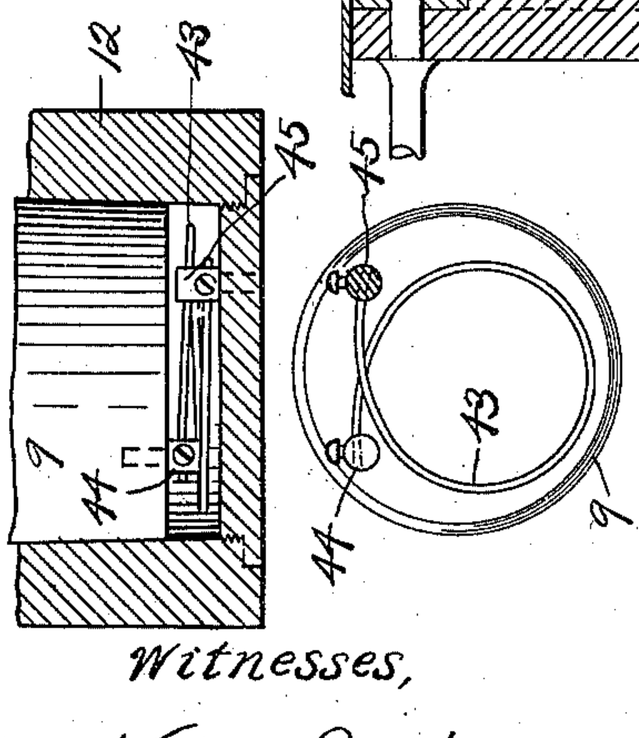

Fig. 8.

Fig. 7.

Witnesses,
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R. M. Combs.

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ROTARY ENGINE.

Application filed Dec. 4, 1901.)

(No Model.)

6 Sheets—Sheet 6.

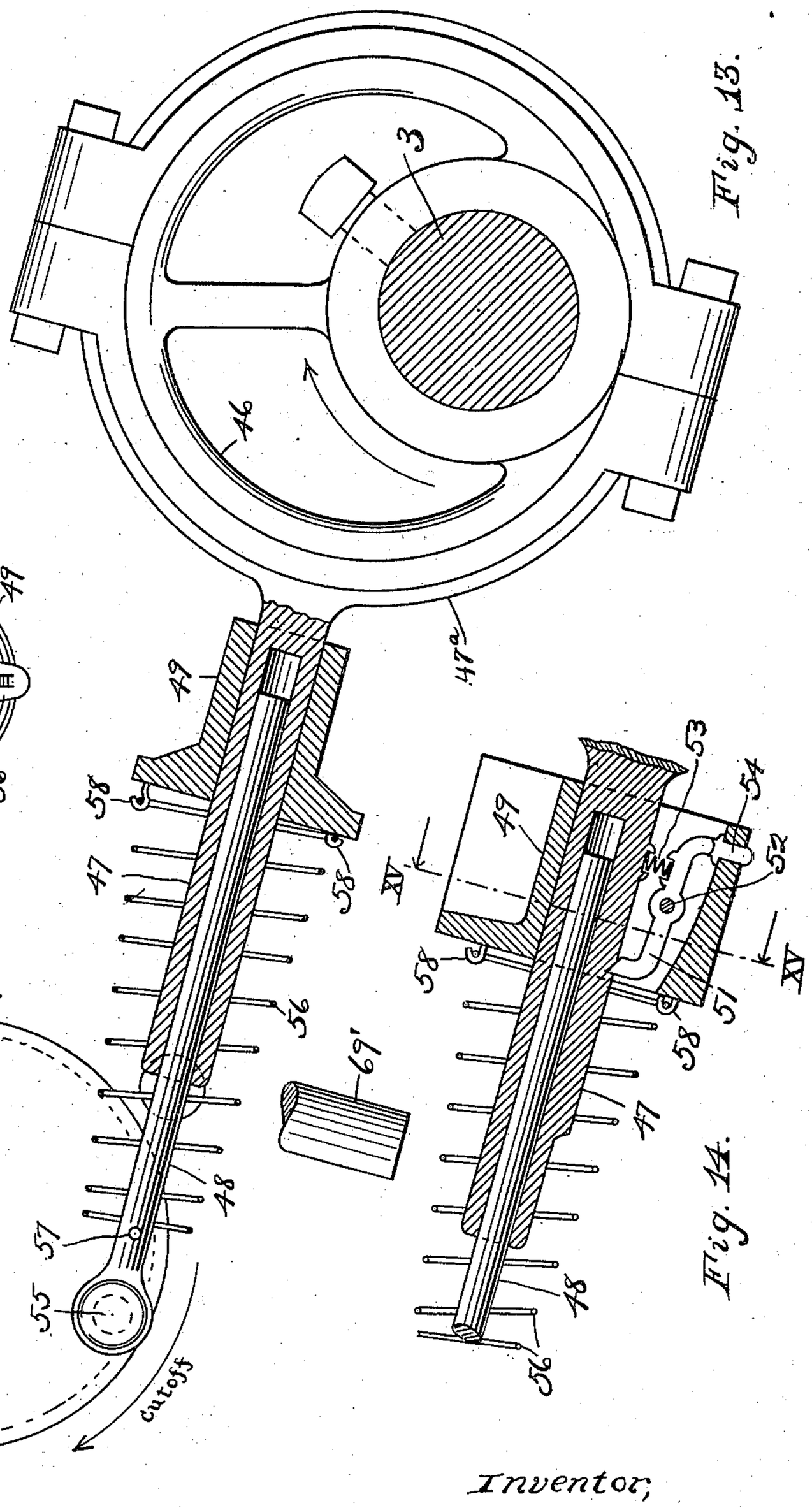

Fig. 14.

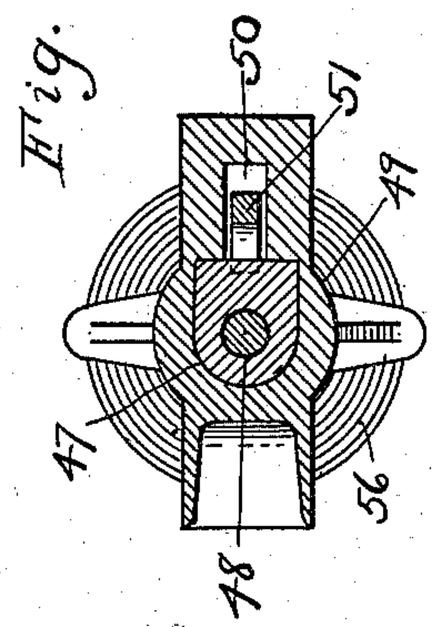

Fig. 15.

Witnesses,
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R. M. Combs.

Inventor,
E. L. Sill.

By Higdon & Longan,
Att'ys.

UNITED STATES PATENT OFFICE.

EDWARD L. SILL, OF GAGE, OKLAHOMA TERRITORY.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 708,415, dated September 2, 1902.

Application filed December 4, 1901. Serial No. 84,628. (No model.)

To all whom it may concern:

Be it known that I, EDWARD L. SILL, of the city of Gage, Woodward county, Oklahoma Territory, have invented certain new and useful Improvements in Steam Rotary Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to improvements in steam rotary engines to be used either for traction purposes or stationary purposes; and my invention consists of the novel features herein shown, described, and claimed.

Figure 1 is a side elevation of an engine embodying the principles of my invention, parts being omitted and other parts being broken away and shown in section. Fig. 2 is a view in elevation showing the opposite side of the engine from Fig. 1, the main shaft being in section and the inlet and exhaust pipes being broken away. Fig. 3 is a cross-section of piston and connecting parts, taken on the line III III of Fig. 5. Fig. 4 is a horizontal longitudinal section of the piston. Fig. 4^a is a detail of one of the piston-packings. Fig. 4^b is an enlarged detail showing the means of packing the piston. Fig. 5 is a top plan view, parts being omitted and other parts being shown in section. Fig. 6 is a vertical section of the piston-cylinder, taken looking toward the ports, the abutment and piston being omitted. Fig. 7 is a horizontal section of the valve-casing and showing a plan of the valve and the spring for returning the valve to the cut-off position. Fig. 8 is a view in elevation of the inner and smaller end of the valve and showing the spring shown in Fig. 7. Fig. 9 is a side elevation of the valve. Fig. 10 is a central longitudinal section of the valve. Fig. 11 is a central longitudinal section of the valve, taken on a line at right angles to Fig. 10 and on the line XI XI of Fig. 12. Fig. 12 is a cross-section of the valve and valve-casing and taken on line XII XII of Fig. 9. Fig. 13 is an enlarged detail, partly in section, of the valve-operating mechanism. Fig. 14 is a sectional detail of the eccentric-rod, taken on a horizontal plane or at right angles to the view shown in Fig. 13. Fig. 15 is a cross-section on the line XV XV of Fig. 14. Fig. 16 is an edge view of the pawl-controlled spring-actuated disk which I employ. Fig. 17 is a face view of the disk shown in Fig. 16. Fig. 18 shows the pawl and wiper which coöperate with the disk shown in Figs. 16 and 17, said pawl and wiper being indicated by the arrow 18 in Fig. 2.

Referring to the drawings in detail, the piston-chamber is formed by the cylinder 1, having its ends closed by the heads 2, and the main shaft 3 is mounted through bearings in the heads 2 and extends through the center of the piston-cylinder. The piston drum or support 4 is rigidly mounted on the shaft 3 in the piston-cylinder, and the piston 5 extends from the drum outwardly to the inner face of the cylinder, said piston being formed integral with the drum or support and extending from one head to the other. The packing-strips 6 are mounted in grooves in the outer edge of the piston 5 and are yieldingly pressed outwardly by the leaf-springs 6^a, the movement of said packing-strips being limited to a few thousandths of an inch by means of the pins 7, inserted loosely through the strips. The packing-strips 6^b are mounted in grooves in the ends of the piston 5 and are yieldingly pressed against the inner faces of the cylinder-heads 2 by means of the leaf-spring 6^c. The packing-rings 6^d are mounted in the concentric grooves 14 in the ends of the drum or support 4, said packing-rings 6^d being yieldingly pressed outwardly against the inner faces of the cylinder-heads 2 by means of the coil-springs 6^e. The inlet-port 8 is formed through the wall of the cylinder 1, and the passage of steam through said port is controlled by the cylindrical rocking valve 9. The sliding abutment 10 is mounted in a slot 10′, formed in the lower part of the valve-chest 12, said abutment being withdrawn once at every revolution of the piston 5 to permit the piston to pass and the inner edge of said abutment pressing against the outer face of the drum 4 except when piston is passing the abutment. The piston 5 and the abutment 10 are beveled from their bases toward their contacting faces as required to allow said piston and abutment to touch sides, or nearly so, during the retreating of the abutment, so that the action of the abutment may take place during a very small part of the revolution of the piston. The packing-strips

13 are inserted in the edge of the abutment 10 and yieldingly press against the drum 4 in a manner similar to the packing in the piston 5. The packing-strips 10^a are placed in grooves in position to be yieldingly pressed against the abutment 10, said strips being located on all sides of said abutment as required to form a steam-tight joint around the abutment.

The cylinder 1 is mounted on the bed-plate 17, said bed-plate extending some distance back of the cylinder, and a bearing-block 16 extends upwardly from bed-plate. The abutment-rod 15 is attached to the abutment 10 and extends backwardly through the bearing-block 16. The central portion 15′ of the rod 15 is enlarged and has a vertical slot 17^a. The antifriction-roller 18 is supported in the slot 17^a by means of the rocker-arm 19, and said arm 19 is keyed to the rock-shaft 20, mounted in the bearings 21. The rocker-arm 22 is secured to the opposite end of the rock-shaft 20 above the arm 19, and the eccentric-rod 23 connects the free end of the rocker-arm 22 to the eccentric 24, mounted on the stub-shaft 25, and said stub-shaft is screwed into the valve-chest 12. The spur-pinion 26 is rigidly attached to the eccentric 24, said spur-pinion being intermittently engaged by the segmental gear 27, fixed on the main shaft 3. The segmental gear 27 and the pinion 26 are so proportioned that the pinion is given exactly one revolution by each revolution of said segmental gear, and the segmental gear is carried by the main shaft and rotates with the piston 5. The disk 28 is secured to the outer face of the eccentric 24 and has a cam-surface 29′ in its outer face, in which is formed a groove 29, said groove extending radially from the outer edge of the disk to a point near its center. The spring-actuated pawl or detent 30 is mounted in a bearing 31, rigidly fixed to the bed-plate and in position to enter the groove 29, and a spring 32 is placed behind the pawl for the purpose of holding it yieldingly in the groove 29. A stud 33 extends laterally from the pawl 30 through a slot in bearing 31, said stud having an inclined cam-face 33′, adapted to be engaged by the wiper-finger 34, carried by the segmental gear 27, said wiper being adapted to push the stud 33 outwardly, thereby withdrawing the pawl 30 from the groove 29, thus leaving the pinion 26 free to be rotated by engagement with the segmental gear 27. The wiper-finger 34 has an inclined face to engage the inclined cam-face of the stud, and when these inclined faces come together the wiper-finger, being rigid in its line of travel, pushes the stud laterally by the sliding of its cam-face upon the cam-face of the wiper-finger. The parts are adjusted so that the abutment 10 normally rests against the drum 4, and when the piston 5 approaches the abutment 10 the wiper 34 moves the pawl 30 out of engagement with the disk 28, the segmental gear 27 engages the pinion 26, and as the pinion 26 is rotated the abutment 10 is withdrawn and allows the piston 5 to pass, and said abutment is again advanced to its normal position. The outer face of the cam-surface 29′ is inclined both ways from the groove 29, and this inclined surface pushes back the pawl 30 during the rotation of the disk until said pawl registers with and snaps into said groove 29. The engagement of the pawl 30 in the groove 29 holds the abutment 10 in its normal position against the drum 4. The crank-pin 70 extends from the disk 28 at a point between groove 29 and the shaft 25, and a retractile spring 69 connects the pin 70 to the upper end of the post 71, said post 71 being rigidly mounted upon the bed-plate 17. The tension of the spring 69 is exerted to move the pinion 26 in the direction of its rotation, so that when the pawl 30 is withdrawn and before the segmental gear 27 has fully engaged the pinion 26 the pinion is started by the spring, and the action of the spring in thus starting the pinion relieves the shock which would result from the collision and sudden engagement of the segmental gear moving at a high rate of speed with the pinion which has been standing still. The complete rotation of the pinion 26 carries the pin 70 around to its starting-point. The first tooth of the segmental gear 27 is shortened to pass one tooth of the pinion 26 before said pinion commences to move, and the second tooth of the segmental gear is so short that it will only engage the tip of the next pinion-tooth, the effect of which is that the movement imparted to the pinion by the second tooth of the gear will not be so rapid or sudden as if said second tooth were of the full length. The counterbalance 35 is cast integral with the hub of segmental gear 27 to balance the weight of the segment.

The engine may be constructed with two of the pistons 5 set opposite each other, and then a companion gear like the segment 27 would be substituted for the counterbalance.

Referring to Fig. 6, the exhaust-port 36 passes through the wall of the cylinder 1 at a point immediately below the abutment 10 and passes laterally around the abutment, as shown in dotted lines, and communicates with the valve 9, as shown in Fig. 12. The supply-pipe 38 leads horizontally to the valve 9, and the exhaust-pipe 39 leads upwardly from the valve. Two recesses 40 are formed in opposite sides of the valve, and the end 37 of the exhaust-port 36 communicates alternately with these recesses 40, said end 37 being near the port 8, as shown in Fig. 3. The recesses 40 are connected at one end of the valve by the large opening 41, which passes directly through the valve. The slot 42 passes through the opposite end of the valve from the opening 41 and communicates with the port 8, as shown in Figs. 3 and 12. The spring 43 is secured at one end to a pin 44, fixed in the end of the valve 9, and said spring is secured at the other end to the pin 45, fixed in the valve-casing, the tension of said spring being

exerted to hold the valve 9 normally in its cut-off position. The details of the spring are shown in Figs. 7 and 8. The eccentric 46 is rigidly mounted upon the main shaft 3, and the tubular eccentric rod or sleeve 47 extends from the ring 47ª of the eccentric. The eccentric-rod 48 is slidingly mounted in the sleeve 47 and connected to the wrist-pin 55, extending from the outer face of the valve 9. The collar 49 is slidingly mounted upon the sleeve 47 and has a slot 50, in which is mounted a pawl 51 upon the pivot 52, the inner end of said pawl being bent inwardly to engage a notch in the sleeve 47 and said pawl being held yieldingly in position by means of the spring 53. A slide 54 is mounted in the bearing in the collar 49, the inner end of said slide being concaved to receive the convexed outer end of the pawl 51. The retractile coil-spring 56 is secured to the collar 49 by means of the hooks 58, and its opposite end is secured to the eccentric-rod 48 by means of a cross-pin 57. The disk 59 is mounted close to the outer face of the collar 49, and a projection 61 extends from the disk 59 in position to engage the button 54 once in every revolution of the eccentric 46, so that said button will be pushed into the collar 49, pressing the pawl 51 out of the notch in the sleeve 47. When the main shaft 3 is rotated to move the eccentric-ring 47ª upwardly and to the right, the sleeve 47 is moved to the right and carries with it the collar 49, and the spring 56 is stretched by the resistance of the valve 9; but the tension of the spring is sufficient to move the valve, thus admitting steam to the piston. Then the button 54 strikes the projection 61 and is pressed inwardly, releasing the pawl 51 and allowing the tension of the spring 56 to move the collar 49, and the tension of the spring 43 closes the valve quickly. When the collar 49 flies back, its motion is limited by a stop 69', projecting from the valve-chest 12. The disk 59 is rotatably mounted upon a stub-shaft 62, said shaft being secured in a bracket 63, bolted to the valve-chest 12. The pinion 64 is secured to the disk 59 and is engaged by a vertical rack 65, mounted in suitable guides in the bracket 63, said rack being adjustable up and down by moving a hand-lever 66, pivoted upon a stub-shaft 68 and connected to the upper end of the rack 65 by the link 67. The path of the projection 61 nearly coincides with the elliptical path of the button 54, so that the point at which the pawl 51 is released from the collar 49 will depend upon the position of the projection 61, and this position is controlled by the hand-lever 66. By this means the amount of steam used at each revolution of the piston may be readily controlled by the driver. A pulley or pinion (not shown) may be secured on either end of the main shaft 3 as a means of transmitting power to the vehicle or other machinery to be operated.

Referring to Fig. 3, when it is desired to start the engine steam is admitted through the pipe 38 to the valve 9 and passes through the opening 42 in the valve 9, then through the port 8 into the space between the abutment 10 and the piston 5, and the expansion of the steam will force the pistou away from the abutment 10, thus rotating the shaft 3 until the piston 5 approaches the abutment from the opposite side. Then the segmental gear 27 will engage the pinion 26 and rotate the shaft 25 and operate the rock-shaft 20 and slide the abutment out of the way of the piston. At the same time the eccentric 46 operates the eccentric-ring 47ª to stretch the spring 56 and move the valve 9 and admit steam to the piston-chamber. Then the trip or projection 61 engages the button 54 to release the collar 49 and allow the spring 43 to close the valve, thus shutting off the supply of steam and allowing that in the piston-chamber to expand. The amount of steam admitted to the piston-chamber is regulated and adjusted by the hand-lever 66 after the engine has been started and may be momentarily varied to suit the occasion.

It is obvious that the engine as described may be duplicated and so connected that one engine may be used in advancing and the other one in backing up, as required to run a wagon, for instance, forward and backward.

I claim—

1. In a rotary engine, a piston-cylinder, a shaft mounted through the center of the cylinder, a cylindrical drum mounted upon the shaft in the cylinder, an abutment slidingly mounted in position to extend into the cylinder and engage the periphery of the drum, an abutment-rod attached to the abutment and slidingly mounted and having a vertical slot at its center, an antifriction-roller mounted in said slot, a rocker-arm supporting said roller, a rock-shaft supporting said rocker-arm, a second rocker-arm attached to the opposite end of the rocker-shaft, an eccentric-rod attached to the second rocker-arm, an eccentric for operating the eccentric-rod, a spur-pinion attached to the eccentric, and a segmental gear attached to the piston-shaft in position to engage the spur-pinion as required to move the abutment out of the way of the piston at each revolution, substantially as specified.

2. In a rotary engine, a piston-cylinder, a shaft mounted in the center of the cylinder, a piston mounted on the shaft in the cylinder, a sliding abutment mounted in position to extend into the cylinder and engage the piston, a port for admitting steam to one side of the sliding abutment, a rocking valve in position to control the passage through said port, a spring in position to hold the rocking valve in position to control the passage through said port, a spring in position to hold the rocking valve normally closed, an eccentric mounted on piston-shaft, a sleeve extending from the eccentric, an eccentric-rod slidingly mounted in the sleeve, a crank attached to the valve and to said eccentric-

rod, a collar mounted on said sleeve, a pawl carried by said collar and in position to removably engage a notch in said sleeve, a tension-spring connecting the sleeve to the eccentric-rod, and an adjustable projection mounted in position to be struck to operate the pawl and release the sleeve as required to release the valve and allow said tension-spring to return it to its normal cut-off position, substantially as specified.

3. In a rotary engine, a piston-cylinder, a shaft mounted in the center of the cylinder, a drum mounted on the shaft in the cylinder, a piston extending from the drum and engaging the inner surface of the cylinder, an abutment slidingly mounted in position to extend into the cylinder and engage the periphery of the drum, locking means for holding the abutment in its normal position against the drum, a tension-spring attached in position to exert its influence toward removing the abutment from its contact with the drum, trip mechanism for unlocking the abutment and the geared connection between the piston-shaft and the abutment whereby the abutment is withdrawn out of the way of the piston at each revolution, the tension of said spring serving to assist in starting the abutment, thereby relieving the shock on the other parts, substantially as specified.

4. In a rotary engine, a sliding abutment mounted in position to coöperate with the piston, lock mechanism for holding the sliding abutment in its normal position, trip mechanism for unlocking the abutment, and geared mechanism for sliding the abutment out of the way of the piston, substantially as specified.

5. In a rotary engine, a piston-cylinder; a shaft mounted in the center of the cylinder; a piston mounted on the shaft and engaging the inner face of the cylinder; a sliding abutment mounted in position to coöperate with the piston; means whereby the abutment is locked in its normal position; trip mechanism for unlocking the abutment; and geared mechanism for sliding the abutment out of the way of the piston, substantially as specified.

6. In a rotary engine, a piston-cylinder; a shaft mounted through the center of the cylinder; a cylindrical drum mounted upon the shaft in the cylinder; a piston extending from the drum to the inner face of the cylinder; a sliding abutment mounted in position to extend into the cylinder and engage the periphery of the drum; means whereby the abutment is locked in its normal position; trip mechanism for unlocking the abutment; and geared mechanism for sliding the abutment out of the way of the piston, substantially as specified.

7. In a rotary engine, a piston-cylinder; a shaft mounted through the center of the cylinder; a cylindrical drum mounted upon the shaft in the cylinder; a piston extending from the drum to the inner face of the cylinder; a sliding abutment mounted in position to extend into the cylinder and engage the periphery of the drum; means whereby the abutment is locked in its normal position; trip mechanism for unlocking the abutment; geared mechanism for sliding the abutment out of the way of the piston; a port leading into the cylinder to one side of the sliding abutment; a valve controlling the passage through said port; and an adjustable means of regulating the valve so as to cut off the steam at any desired point of the piston in the revolution, substantially as specified.

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

EDWARD L. SILL.

Witnesses:
J. L. PRYOR,
HENRY HAUSEN.