No. 747,727. PATENTED DEC. 22, 1903.

I. V. KETCHAM.

ROTARY ENGINE.

APPLICATION FILED OCT. 1, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 2.

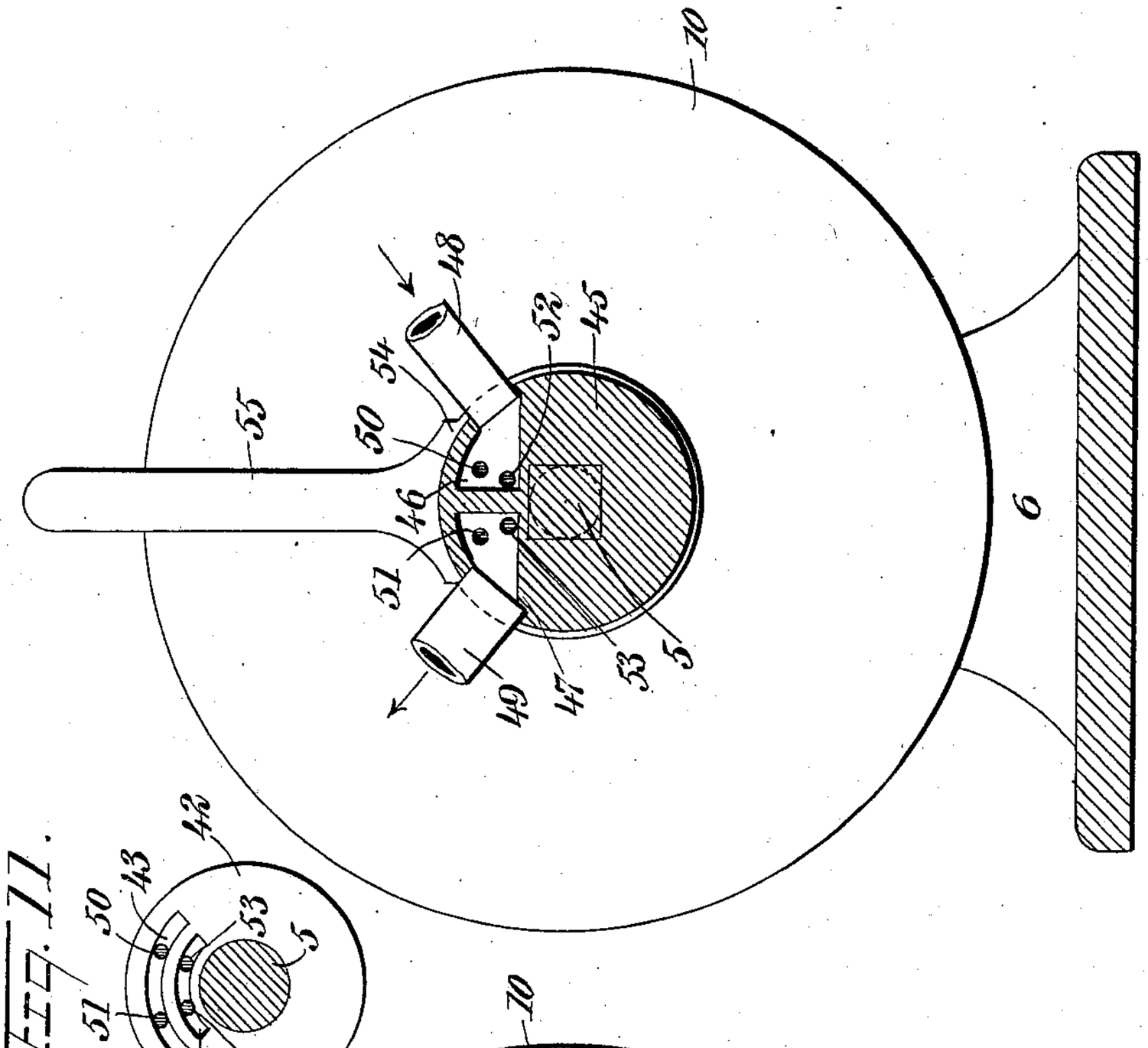
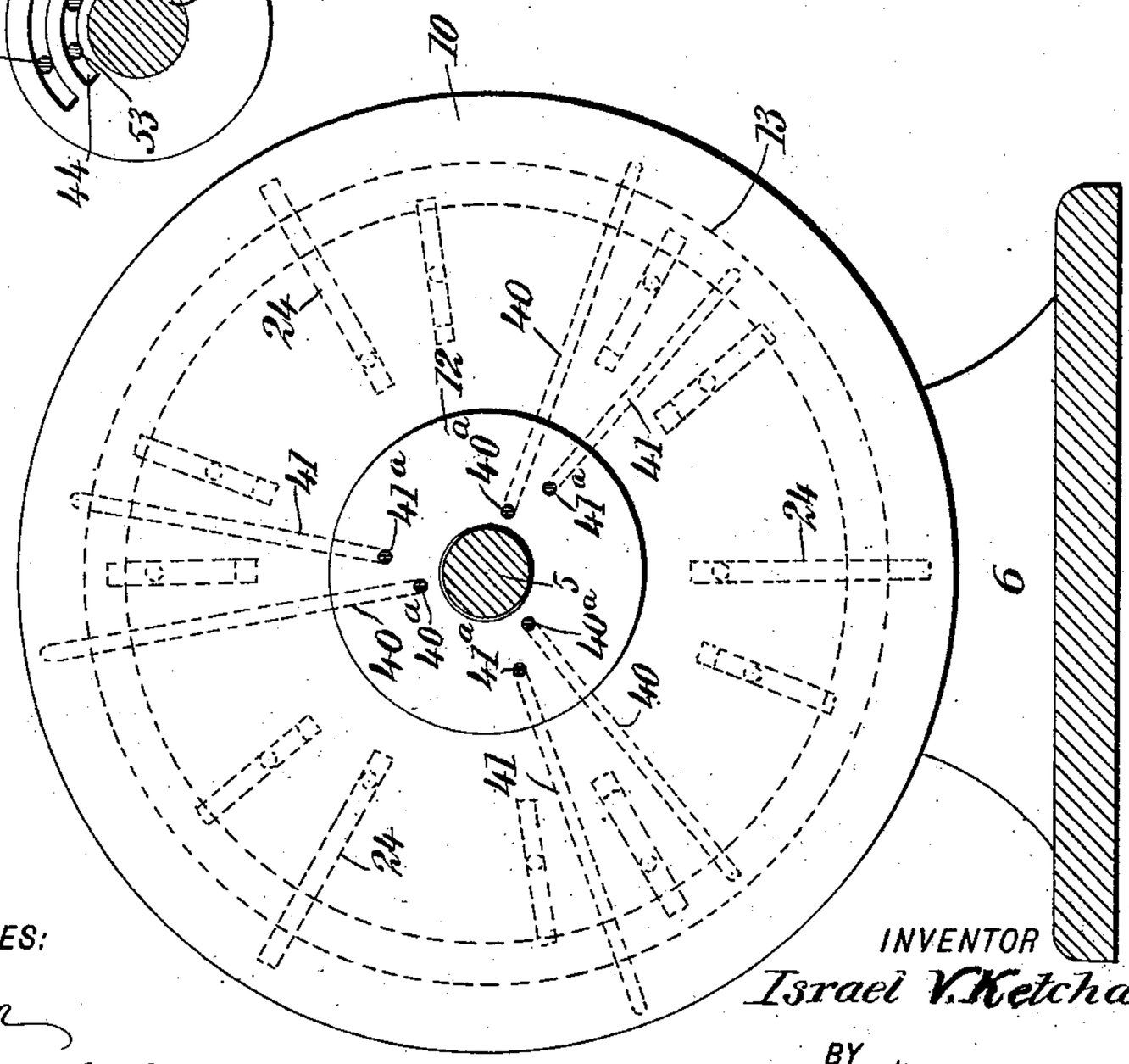


FIG. 11.

FIG. 1.



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NO MODEL. 3 SHEETS—SHEET 2.

FIG. 4.

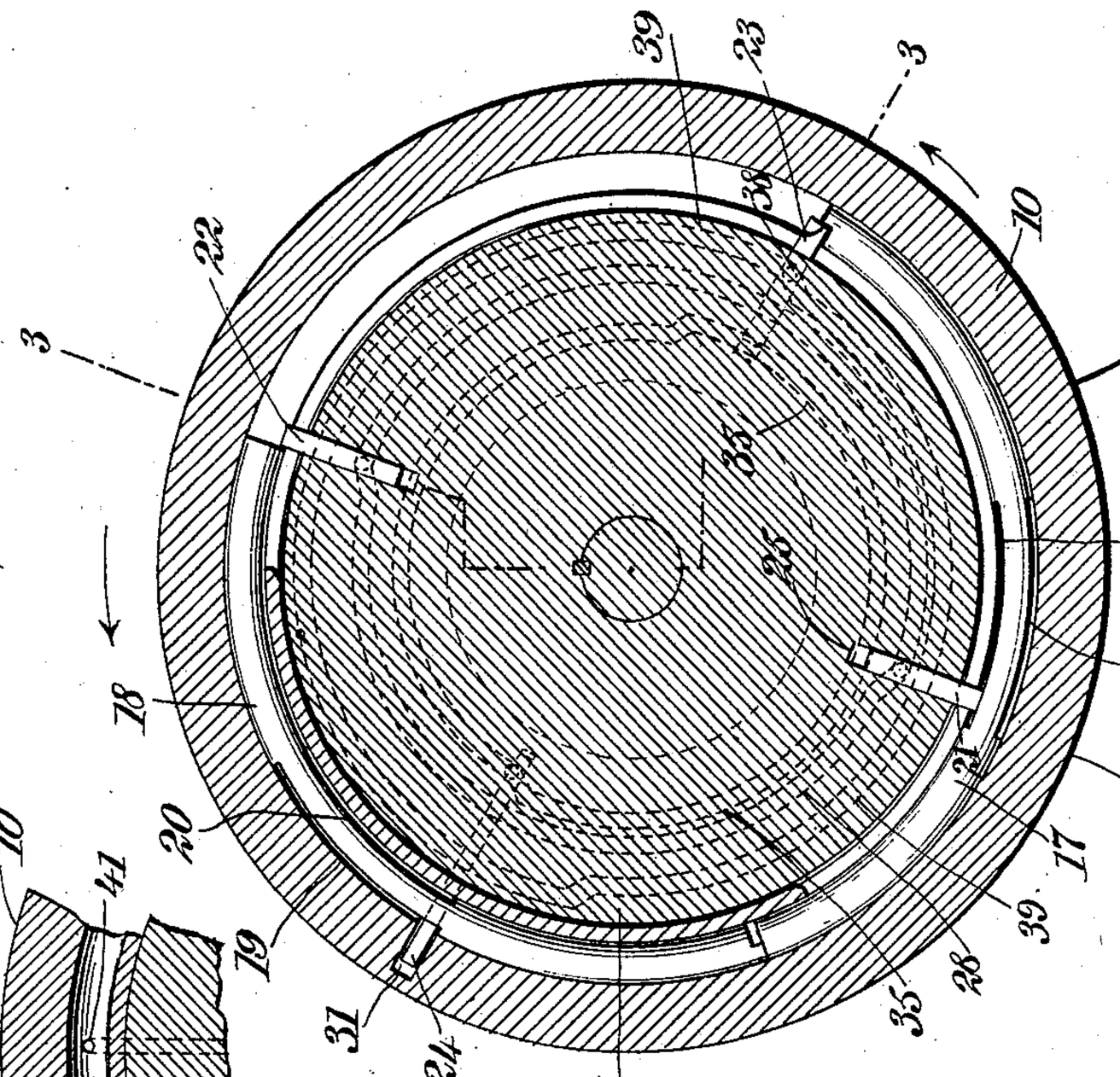
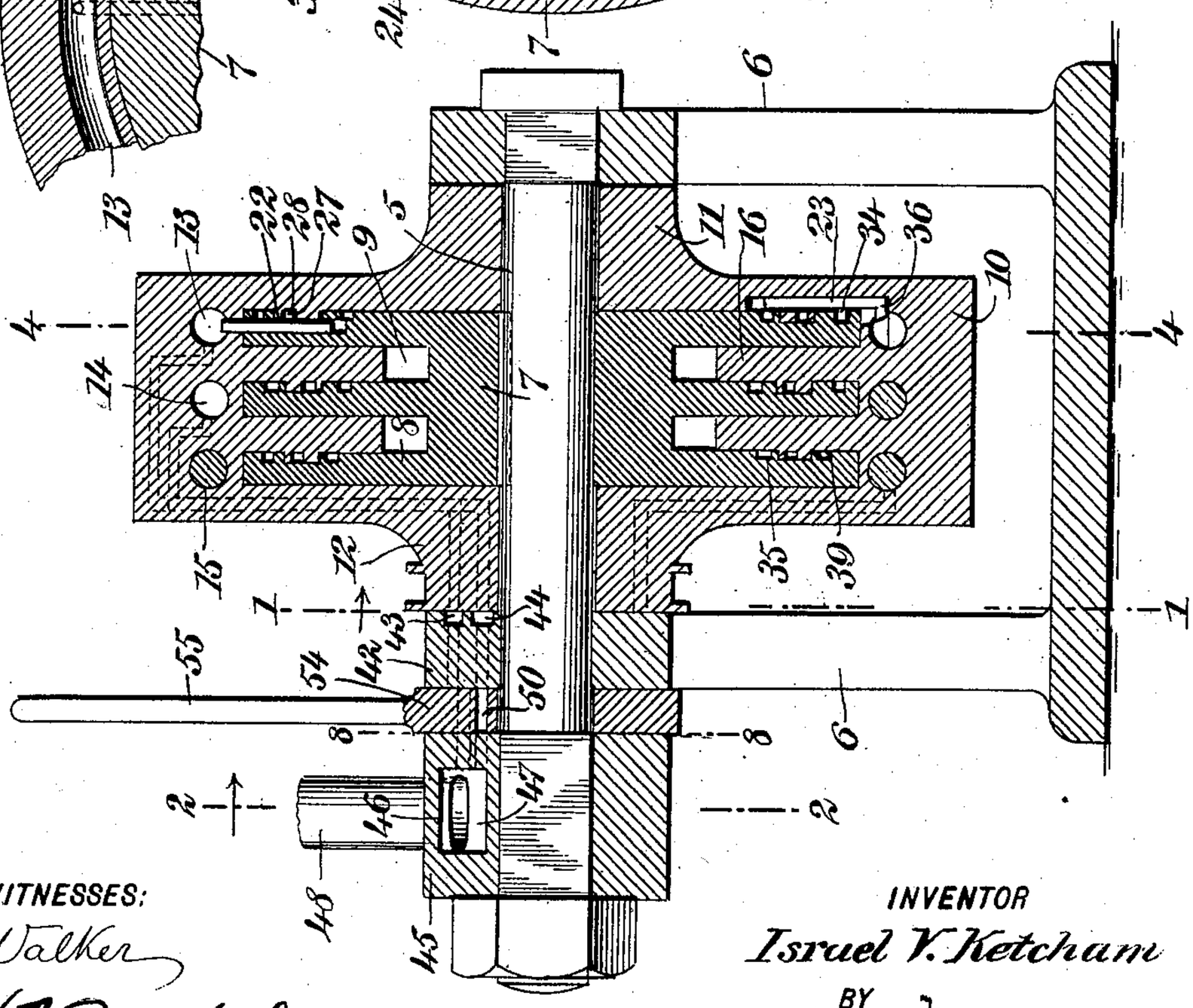


FIG. 12.

FIG. 3.



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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 10.

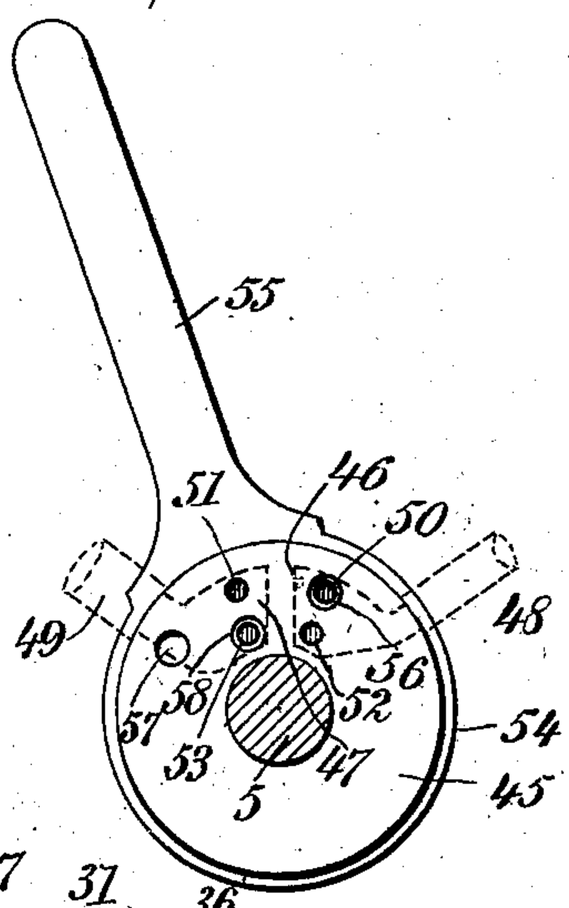


Fig. 8.

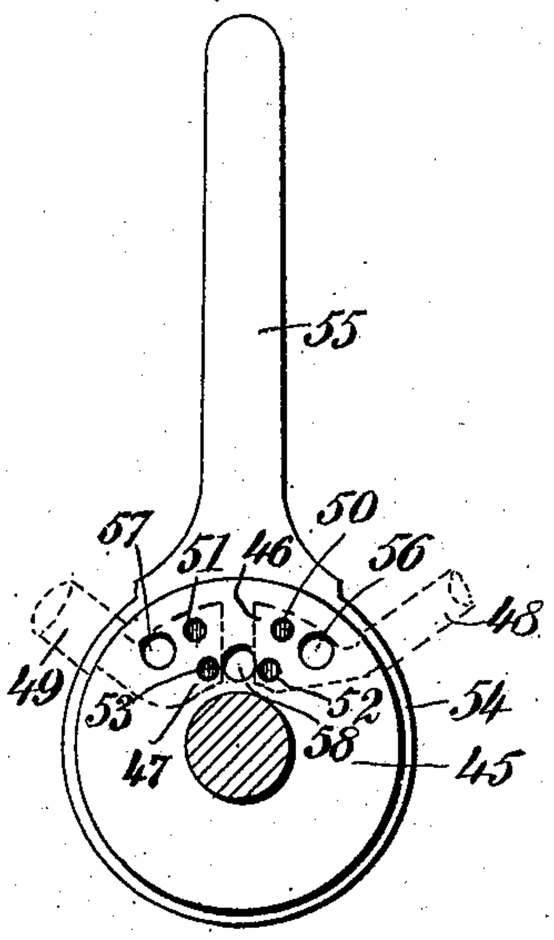


Fig. 9.

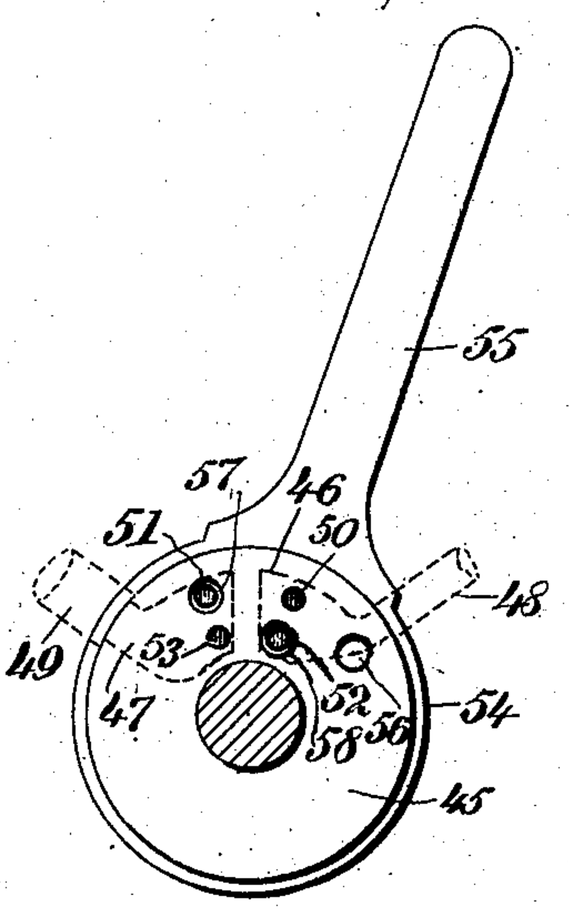


Fig. 7.

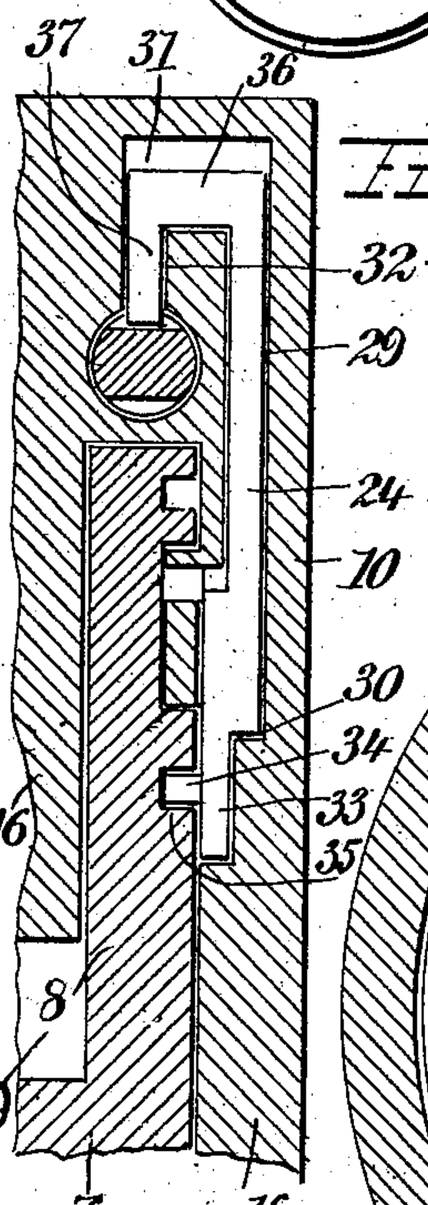


Fig. 6.

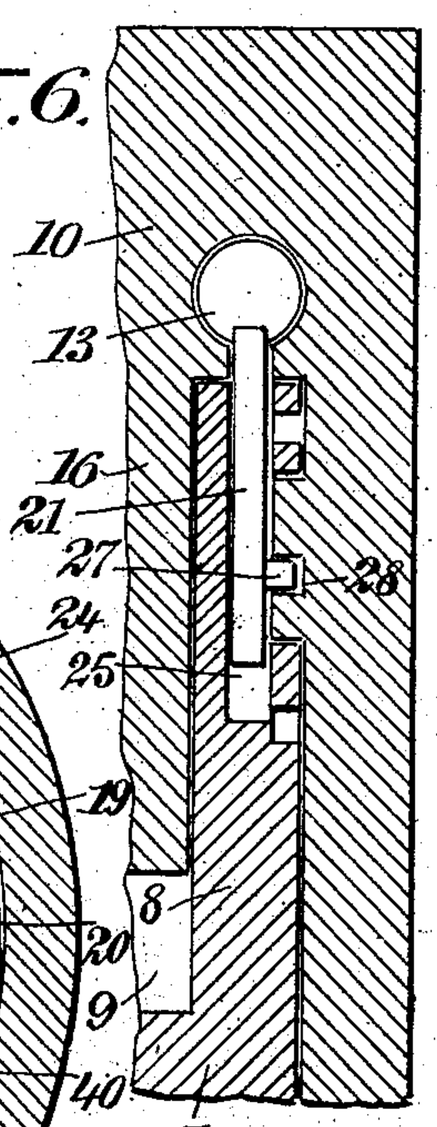
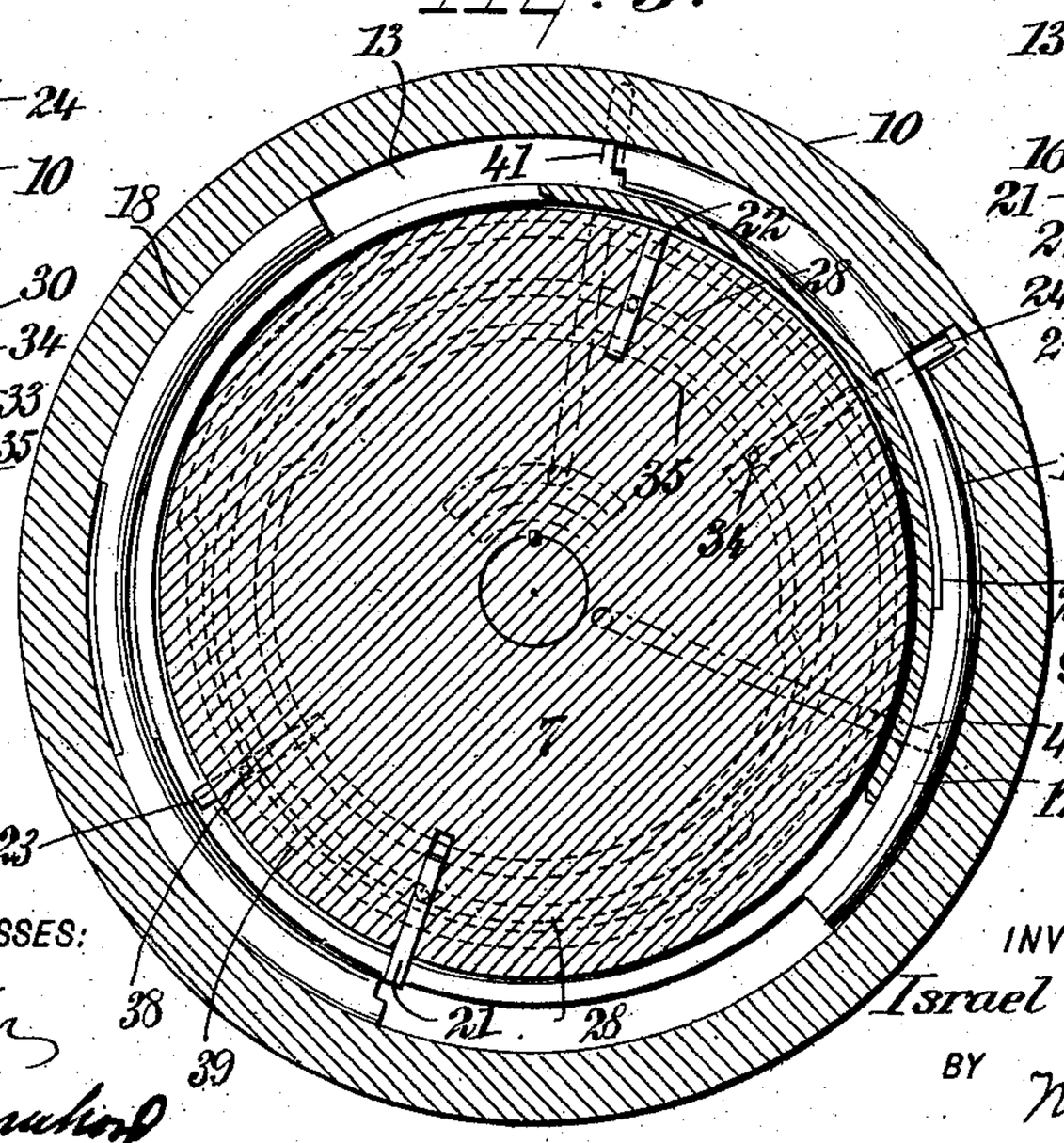


Fig. 5.



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No. 747,727. Patented December 22, 1903.

UNITED STATES PATENT OFFICE.

ISRAEL V. KETCHAM, OF NEW YORK, N. Y.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 747,727, dated December 22, 1903.

Application filed October 1, 1903. Serial No. 175,312. (No model.)

To all whom it may concern:

Be it known that I, ISRAEL V. KETCHAM, a citizen of the United States, and a resident of the city of New York, borough of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Mechanical Device for Pulleys, Wheels, Rotary Engines, and other Purposes, of which the following is a full, clear, and exact description.

My invention relates to a mechanical device adapted to be embodied in the construction of rotary engines, pulleys, wheels, rams, and other structures.

The object of this invention is to provide a compact and simple construction wherein the power may be augmented without a corresponding increase in the pressure of the motive fluid.

Further objects and advantages of the invention will appear in the course of the subjoined description, and the actual scope thereof will be defined by the annexed claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional elevation on the line 1 1 of Fig. 3 looking in the direction of the arrow and illustrating by dotted lines the arrangement of the several inlet and exhaust passages and the devices in the rotary and stationary members of the engine shown by the drawings. Fig. 2 is a sectional elevation through the steam-chest on the line 2 2 of Fig. 3. Fig. 3 is a vertical transverse sectional elevation taken in the plane indicated by the irregular line 3 3 of Fig. 4. Fig. 4 is a vertical cross-section on the line 4 4 of Fig. 3. Fig. 5 is a cross-section similar to Fig. 4, but showing certain of the parts in different positions. Fig. 6 is an enlarged detail sectional view through a portion of the rotary and stationary members, illustrating one of the slides, which are mounted in the stationary part for radial movement therein. Fig. 7 is another vertical transverse sectional elevation illustrating one of the slides, which is adapted to travel with the rotating member and is capable of an independent radial movement therein. Figs. 8, 9, and 10 are views showing different positions of a valve, the plane of the section of Fig. 8 being indicated by the dotted line 8 8 of Fig. 3. Fig. 11 is a cross-section on the line 1 1 of Fig. 3 looking in an opposite direction to the arrow and showing the arcuate chambers and the steam-ports in the collar 42, and Fig. 12 is a detail section showing one of the steam-passages to a piston-chamber in the rotary member.

In the embodiment of the invention illustrated by the drawings I have shown the machine adapted for use as a rotary engine; but it will be understood that I do not limit the invention to this specific application, because I am aware that it may be embodied in the construction of pulleys, wheels, rams, and other structures. As shown, I employ a stationary arbor 5, which is supported in suitable posts 6, although these posts may be omitted and the arbor may be held in a stationary position by any suitable devices. Fixed to this arbor in any suitable way is a stationary member 7, which is shown as having a plurality of concentric radial partitions 8, which are spaced to form a plurality of annular grooves 9.

10 designates the rotary member, which is provided with hubs 11 12, that are loosely fitted on the arbor 5, the hub 12 being constructed to provide for the inlet and exhaust of a motive fluid to a plurality of chambers 13, 14, and 15, which are provided in the rotary member 10. Said rotary member is constructed or fashioned to inclose or house the stationary member 7, and the rotary member is provided with a plurality of inwardly-extending partitions 16, which are arranged to project into the spaces 9 of the stationary member, whereby the partitions of the rotary and stationary members are disposed in lapping relation, as shown more clearly by Fig. 3. Each chamber 13, 14, and 15 of the rotary member is constructed and equipped in the same way as every other chamber, and a description of one will answer for the others.

In each chamber I provide a pair of arcuate or segmental pistons 17 18, the length of each piston being more than one-third the circumference of the rotary member. Each piston is shown as having a longitudinal groove 19 in its outer side and a similar groove 20 in its inner side, and with this pair of pistons coöperates a series of slides 21 22 23 24. The slides 21 22 are supported by the station-

ary member 7, and they are fitted loosely in slots 25, which are provided in said stationary member at diametrically opposite points, each of said slides being capable of a radial movement with respect to the stationary and rotary members of the structure. Fig. 6 of the drawings shows one of these slides and its complementary parts on an enlarged scale, and by reference to this figure it will be seen that the slide is provided with a pin or stud 27, which projects into a cam-groove 28, the latter being provided in one wall of the rotating member 10, said groove 28 having two or more offsets, as indicated by dotted lines in Figs. 4 and 5, and the one groove 28 being common to the pair of slides 21 22, which are mounted in the stationary member 7 and are adapted to coöperate with the pair of pistons in one of the piston-chambers, whereby the rotation of the member 10 will at proper intervals actuate the slides 21 22, so as to project and withdraw them as required.

The rotating member 10 of the structure carries with it the two remaining slides 23 24, the slide 24 being shown in detail by Fig. 7 of the drawings. As shown by said figure, the rotary member 10 is provided with a radial groove 29, having a shoulder 30 at its inner end and an offset 31 at its outer end, said offset communicating by a branch groove or slot 32 with one of the piston-chambers of the rotary member. The slide 24 is at its inner end provided with a shank 33, the latter having a stud 34, which is arranged to project into a cam-groove 35, which is provided in one of the partitions 8 of the stationary member 7. Said slide 24 is furthermore provided with an offset head 36, which terminates in a beak 37, said head and beak being arranged to play in the offset 31 and the slot 32 of the guide-groove 29, as shown by Fig. 7. The slide 24 is mounted in the rotating member 10, so as to travel therewith and to have a certain amount of independent radial play when the stud 34 travels in the different parts of the cam-groove 35, which are provided in the stationary member 7, and this cam-groove should be fashioned and arranged to impart the desired movement to the slide 24 during the rotation of the member 10. The other slide 23, which travels with the rotating member 10, is fitted in a radial groove which is provided in one of the partitions 16 of said rotating member, said slide 23 being arranged in position diametrically opposite to the slide 24, as shown by Figs. 4 and 5. This slide 23 is adapted to be interposed in the path of either of the pistons 17 18, and it is furnished with a stud 38, which is arranged to travel in a cam-groove 39, as indicated by dotted lines in Figs. 4 and 5, whereby the slide 24 is adapted to rotate with the member 10, and it is projected and retracted at intervals by its stud 38, riding in the cam-groove 39. From this description it will be seen that in connection with each piston-chamber I employ a pair of pistons 18 19, two slides 21 22, which are mounted in the stationary member 7 and are adapted to be projected and withdrawn by a single cam-groove 28, provided in the rotating member 10, and another pair of slides 23 24, which rotate with the rotary member and are actuated as required by cam-grooves which are provided in the stationary member, said slides 23 24 being controlled by independent cam-grooves in the stationary member. The several pistons and slides in connection with each piston-chamber are disposed to drive the rotary member 10 for a part of each rotation, the pistons in the several piston-chambers being effective successively in driving the member 10 for each complete rotation. It is to be understood that one set of pistons become active in driving the rotary member for a third of its rotation, the next set of pistons are effective in driving the rotary member another third of the rotation, and the third set of pistons drive the rotary member for the remaining distance to complete the rotation. To this end the several pistons and their coöperating devices should be arranged for successive operation in a manner which will readily suggest itself to those skilled in the art.

The rotary member 10 is provided with a plurality of pairs of steam-passages 40 41, the passage 40 of each pair constituting the inlet for the live motive fluid to the piston-chamber and having a branch passage which extends through the hub 12 and terminates in a port 40^a, whereas the other passage 41 has communication with the same piston-chamber as the passage 40, so as to form an exhaust-passage for the motive fluid, said exhaust-passage 41 having another branch passage which extends through the hub 12 and terminates in a port 41^a, as shown more clearly by Figs. 1 and 3. The remaining piston-chambers are supplied with live motive fluid by passages in the rotary member and the hub thereof similar to the passage 40, while the exhaust fluid is conveyed from the piston-chambers by passages similar to the passage 41. The ports 40^a of the inlet-passages are disposed at the same distances from the center of the arbor 5 equidistantly one from the other, whereas the ports 41^a of the exhaust-passages are equidistantly disposed with relation to each other and farther from the axis of the arbor than the ports 40^a, whereby the group of exhaust-passages lies within or farther from the axis of rotation of the member 10 than the inlet-passages 40^a of the other group.

Adjacent to the hub 12 is a stationary collar 42, which is provided with non-communicating arcuate chambers 43 44, which are disposed in the planes of the inlet-ports 40^a and the exhaust-ports 41^a, respectively, whereby the inlet-ports 40^a are adapted to communicate successively with the chamber 43, and in like manner the exhaust-ports 41^a will communicate with the chamber 44 during each

complete rotation of the member 10, thus supplying steam or other motive fluid successively to the piston-chambers 13 14 15 and exhausting the spent fluid successively from said piston-chambers during the rotation of said member 10.

45 designates a steam-chest which is mounted in a stationary position on an extended end portion of the arbor 5, and, as shown by Fig. 2 of the drawings, this chest is provided with a live-steam chamber 46 and with an independent non-communicating exhaust-steam chamber 47. The live-steam pipe 48 is coupled to the chest for communication with the chamber 46, and an exhaust-pipe 49 is coupled to the chest for communication with the chamber 47. The chest is provided with ports 50 52, which communicate with the chamber 46 and with other ports 51 53, which communicate with the exhaust-chamber 47. Between the collar 42 and the steam-chest 45 is interposed a valve, which is shown in the form of a ring 54, said ring having a handle 55 for its convenient manipulation. The valve-ring is provided with a group of three ports 56, 57, and 58, and, as shown by Figs. 8, 9, and 10, the ports 56 and 57 are adapted to have communication individually with the ports 50 or 51, which are provided in the steam-chest and in the collar 42, whereas the remaining port 58 is adapted to have communication with either of the ports 52 or 53, which are provided in the steam-chest and in said collar 42, the collar 42 being provided with steam ports or passages similar to those which are formed in the steam-chest, as indicated by Figs. 3 and 11. The valve may occupy the neutral position shown by Fig. 8, wherein its ports 56, 57, and 58 cut off communication between the steam-chest, the collar 42, and the passages of the rotary member; but this valve may be shifted to either of the positions shown by Figs. 9 and 10 in order to direct the live and exhaust steam through the engine in the proper way for the purpose of driving it in one direction or the other.

The operation of the apparatus may be described as follows: When the valve 54 is shifted to the position shown in Fig. 9, live steam passes through the ports 52 58 and the collar to the passage 40 of one piston-chamber, as 13, the pistons 17 18 in which occupy the positions shown in Fig. 4. Steam is admitted by a port located between the contiguous ends of the pistons, one of which, 17, is made to rotate with the member 10 because its free end abuts against the slide 23, so that the pressure of the admitted steam will act against the other end of the piston to force it, the slide 23, and the member 10 in the direction of the arrow in Fig. 4. At this time the slide 21 is withdrawn from the piston 17, while the slide 22 is projected into engagement with the other piston 18, and the slide 24 is withdrawn from the piston 18, so that the latter remains at rest while the slide 24 rotates with the member 10. After the piston 17 is impelled by the steam far enough to rotate the member 10 for a third of its revolution the exhaust-port 41^a is uncovered in the piston-chamber and the steam is admitted by another passage 40 to the next piston-chamber, as 14, so as to actuate the pistons therein in the same manner as the piston 17 is driven in the chamber 13. When the steam admitted to the chamber 13 has practically expended its energy, the member 10 continues to rotate and the slide 23 travels therewith, so as to pass the slide 22 and to engage with the rear end of the piston 18, the piston 17 being arrested by the slide 22, the latter being withdrawn at the proper interval. The slide 23 carries with it the piston 18, so as to move it to the position with relation to the inlet-port formerly occupied by the piston 17, and when this is accomplished the slide 23 is withdrawn and the slide 21 is projected to engage the groove 20 of the piston 18, thus holding it in the position ready for operation. In the meantime the slide 24 is carried by the turning of the rotary member 10 into position where it will engage with the shouldered outer side of the piston 17, so that on the continued movement of the member 10 the slide 24 and the piston 17 will be carried around for the latter to take the position formerly occupied by the piston 18, the slide 22 in the meantime being withdrawn from the path of the piston 17. The positions of the pistons 17 and 18 are thus reversed, so that the piston 18 will be effective in partially rotating the member 10 on the next rotation thereof. It should be understood that the slides 21 and 24 only hold the pistons in place until the slides 22 and 23 slide out and lock the pistons, one to the stationary part and the other to the movable part. While these changes in the positions of the pistons 17 18 of the chamber 13 are being effected the steam is admitted to the remaining chambers 14 15 successively, so as to make the pistons therein available in driving the member 10 to complete the rotation thereof, and thus the sets of pistons are brought into service one after the other in the propulsion of the engine. It is evident that the rotation of the member 10 brings the parts 40^a 41^a into communication with the chambers 43 44, so as to supply steam to and exhaust it from the chambers 13 14 15. To reverse the engine, the valve is shifted to the position of Fig. 10 to make the port 56 register with the passage 50 and the port 58 to register with the passage 53, thus reversing the direction of supply to the chambers 43 44 and to the passages 40 41.

Although I have shown and described the rotary member as having three of the steam-chambers and their complemental parts, it is to be understood that I may employ four or more of the chambers, pistons therein, and the supply and exhaust passages, with their ports, thereby multiplying the number of ports adapted for communication with the

chambers 43 44. This overcomes to a large extent the possibility of the rotary member stopping at a place where the ports will not communicate with the chambers 43 44, and provision is thus made for promptly starting and reversing the engine.

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

1. An apparatus of the class described, having a stationary member provided with a plurality of cam-grooves, a rotary member having a plurality of piston-chambers and also provided with a plurality of cam-grooves, a plurality of pistons in each of said piston-chambers, and slides in coöperative relation to said pistons and actuated by the cam-grooves of the rotary and stationary members.

2. An apparatus of the class described, having a stationary member provided with a series of partitions each having a plurality of cam-grooves, a rotary member having piston-chambers and a single cam-groove related to each piston-chamber, a pair of arcuate pistons in each of said piston-chambers of the rotary member, a pair of slides mounted in the stationary member for coöperation with the pistons of each piston-chamber and controllable by the cam-grooves of the rotary member, and another pair of slides rotating with the rotary member for coöperation with the pistons in one of the piston-chambers and controllable by cam-grooves of the stationary member.

3. An apparatus of the class described, having a stationary member, a rotary member provided with a hub and a series of piston-chambers and with separate pairs of inlet and exhaust passages which communicate with the piston-chambers individually and terminate in separate ports in said hub of the rotary member, a collar having passages and chambers disposed for communication with the inlet and exhaust ports respectively in the hub of the rotary member, a chest, and a valve.

4. An apparatus of the class described, having a stationary member, a rotary member having its hub provided with a plurality of pairs of inlet and exhaust ports, a collar having non-communicating chambers disposed in positions for communication successively with the respective ports in said hub of the rotary member, a pressure-chest having separate chambers and pistons corresponding to the passages of the collar, and a valve between said collar and the chest.

5. A rotary engine having a stationary member, an annular member revolubly mounted on said stationary member and provided with a plurality of non-communicating annular piston-chambers, means for admitting motive fluid successively to said chambers of the revoluble member during each rotation thereof, a plurality of arcuate pistons in each piston-chamber of the revoluble member, and means for shifting and locking the pistons in each piston-chamber of said revoluble member; the arrangement being such that the pistons of the different groups in the different piston-chambers are effective successively in driving the revoluble member during each rotation thereof.

6. A rotary engine having a stationary member, an annular member revolubly mounted thereon and provided with a plurality of non-communicating annular piston-chambers, a plurality of arcuate pistons in each piston-chamber of the revoluble member, locking devices mounted in the stationary member and controllable by the revoluble member for temporarily holding the pistons against travel, coupling devices carried by the revoluble member and controllable by the stationary member for making the pistons fast with said revoluble member and for shifting the positions of the pistons in said piston-chambers, and means for admitting motive fluid to the piston-chambers successively and bringing the different sets of pistons into action in like order during each complete rotation of the revoluble member.

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

ISRAEL V. KETCHAM.

Witnesses:
JNO. M. RITTER,
H. T. BERNHERD.