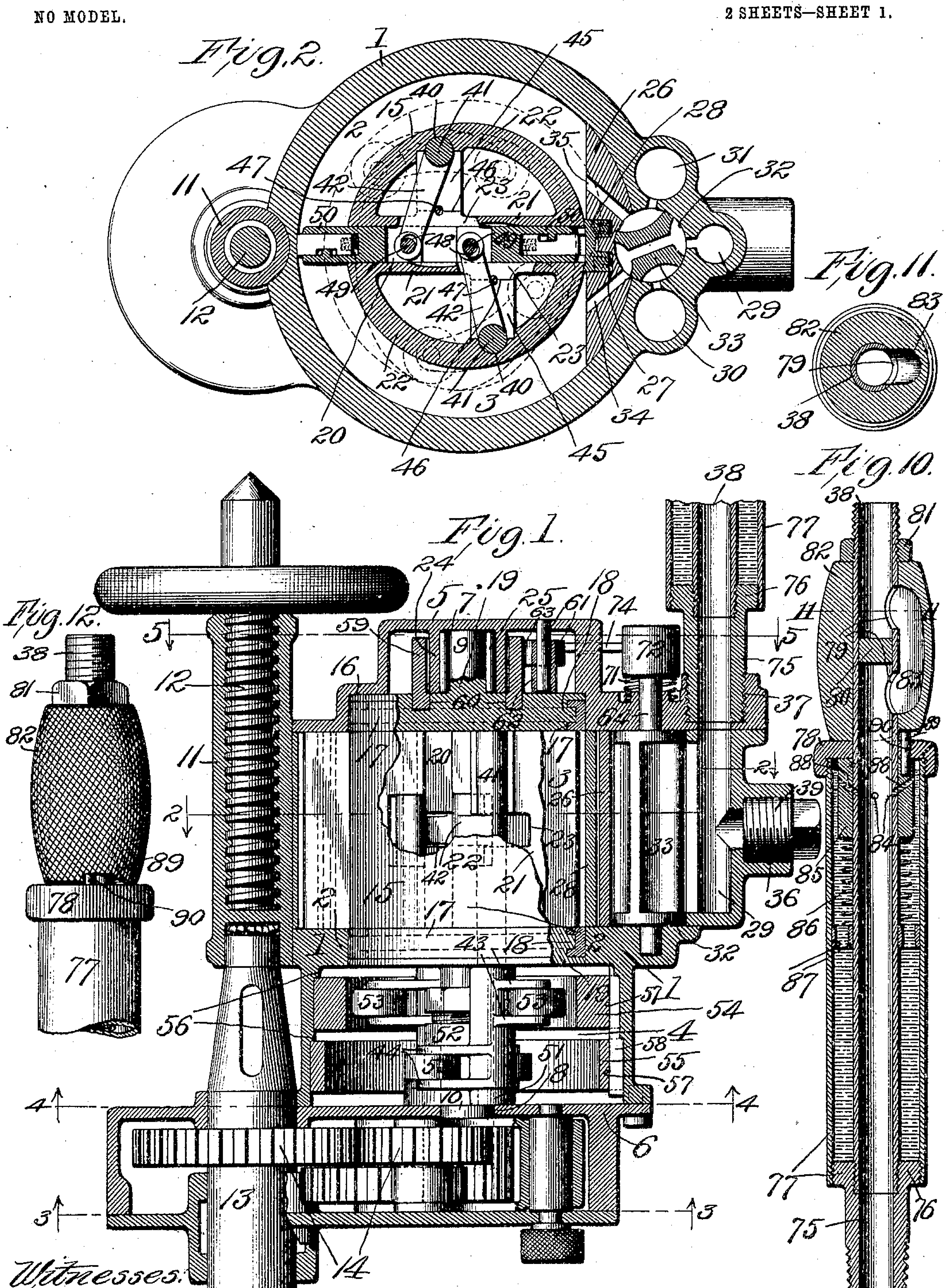
No. 775,429. PATENTED NOV. 22, 1904.

J. W. PICKEL.

ROTARY ENGINE.

APPLICATION FILED JULY 21, 1902.

NO MODEL. 2 SHEETS—SHEET 1.



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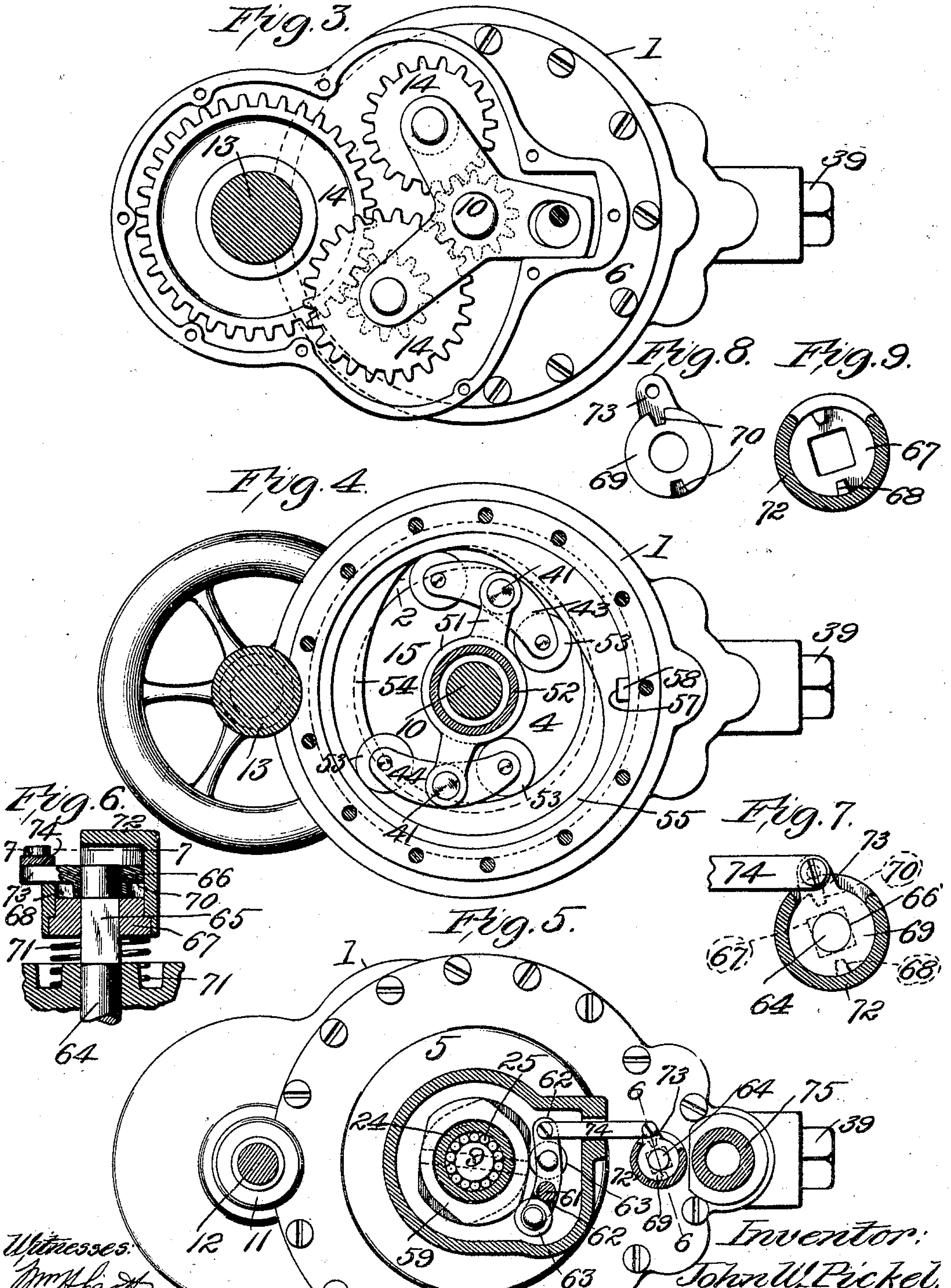

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UNITED STATES PATENT OFFICE.

JOHN W. PICKEL, OF CRYSTAL CITY, MISSOURI, ASSIGNOR OF THREE-EIGHTHS TO JESSE F. DONNELL AND PAUL LORENZ, OF FESTUS, MISSOURI, AND LOUIS PHILLIPPI AND ROBERT SNYDER, OF CRYSTAL CITY, MISSOURI.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 775,429, dated November 22, 1904.

Application filed July 21, 1902. Serial No. 116,389. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. PICKEL, a citizen of the United States, residing at Crystal City, Jefferson county, State of Missouri, have invented a certain new and useful Improvement in Rotary Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is an elevation chiefly in central vertical section. Fig. 2 is a transverse view on the line 2 2 of Fig. 1. Fig. 3 is a bottom plan view on the line 3 3 of Fig. 1. Fig. 4 is a bottom plan view on the line 4 4 of Fig. 1. Fig. 5 is a top plan view on the line 5 5 of Fig. 1. Fig. 6 is a fragmentary detail, chiefly in longitudinal section, on the line 6 6 of Fig. 5, illustrating the connection between the valve-stem and the member for actuating the same. Fig. 7 is a sectional view on the line 7 7 of Fig. 6. Fig. 8 is a view showing the inner face of the rocking plate for actuating the valve-stem. Fig. 9 is a detail view showing the member which coöperates with the rocking plate shown in Fig. 8. Fig. 10 is a longitudinal sectional elevation of the handle and fluid-supply pipe. Fig. 11 is a detail sectional view on the line 11 11 of Fig. 10, and Fig. 12 is a fragmentary view showing a portion of the handle in elevation.

My invention relates to improvements in rotary engines, my object being to provide a light, compact, and efficient device of the character indicated particularly adapted to use in portable drills, although the said engine is in no wise limited to such use.

To these ends and also to improve generally upon devices of the character indicated my invention consists in the various matters hereinafter described and claimed.

As the present engine is particularly adapted for use in portable drills, I have herein illustrated the engine in connection with such a drill. No claims are made in this case to the subject-matter of the drill, however, as said drill forms the subject-matter of my application, Serial No. 91,669, filed January 29, 1902.

Referring now more particularly to the drawings, 1 represents the main casing, which is of general cylindrical form and has intermediate its ends and parallel thereto an interior annular rib 2, which divides said casing into chambers 3 and 4, respectively, chamber 3 forming the cylinder of the engine and chamber 4 housing certain operating parts, to be more fully hereinafter described. Heads 5 and 6 close the ends of said main casing and are provided with bearings 7 and 8 for the shafts 9 and 10 of the engine, said bearings being concentric with the inner circumference of the annular rib 2. The casing is provided with a boss 11, which has a seat for the feed-screw 12 and also an end bearing for the drill-spindle 13, and said spindle is driven from the shaft of the engine through any suitable connections, these connections being here shown as the train of gears 14.

The piston 15 is seated at one end against the inner circumference of the before-mentioned annular rib 2 and is of such length that it extends beyond the end of the main casing 1 and is received in a recess 16 in the inner face of the head 5, suitable expansible packing-rings 17 being interposed between the piston ends and the said rib and annular wall of the said recess. These rings are grooved, as shown, upon their inner faces, whereby they are substantially U-shaped in cross-section, and are received in appropriate grooves in the piston, suitable tongues 18, formed upon the piston, extending into the packing-ring grooves. Thus a most tortuous passage is presented to any air or other operating fluid which may tend to escape. Furthermore, these rings fit the piston and the inclosing walls sufficiently tightly to effectually prevent the escape of the motive fluid; but at the same time they are not rigidly fastened upon the

piston, whereby they can either revolve therewith or cling to the cylinder-wall, thus permitting the movement of the piston to take place between the surfaces which may present the least resistance, and thereby reducing friction and facilitating light running of the engine. I prefer to construct the piston of a single casting which has solid ends 19 and has a slot 20 extending diametrically between said ends, said slot having each of its ends opening upon the periphery of the piston. Web plates or walls 21 extend across the piston at the sides of the said slot, and between the said plates and the circumferential wall 22 the piston is cored, as shown in Fig. 2. Each of the webs or plates 21 is provided with a slot 23 for a purpose to be more fully hereinafter explained.

Integral with the ends of the piston are outwardly-extending trunnions or shafts 9 and 10, the shaft 10 carrying the driving-gear and the shaft 9 being journaled in the bearing 7 upon the head 5. The said bearing is produced by an inwardly-extending annular wall 24, cast upon the head 5, and suitable bearing-rollers 25 are preferably introduced between the periphery of the said shaft and the innner circumference of the said wall. The shaft end preferably abuts against the inner face of the head 5.

Preferably the bore of the casing which forms the engine-cylinder is turned out perfectly round, and a segmental block 26 is secured therein at an appropriate point, said block extending the length of the cylinder and having in its face adjacent the piston a recess 27, which receives a suitable abutment 28. This structure greatly simplifies the manufacture of the engine, it being only necessary to turn out the cylinder, cut the block, and then assemble the parts. At about the position of the said block the casing is enlarged and provided with chambers 29, 30, and 31, the first of these being an inlet-chamber and the others being outlet-chambers, while a cylindrical valve seat or box 32 for the valve 33 is formed intermediate the two outlet-chambers and between the inlet-chamber and the cylinder. Appropriate ports connect the various chambers with the valve-seat, and ports 34 and 35 lead through the block 26 from the said valve seat or box to opposite sides of the abutment. The valve being provided with the passages usual in a valve applied to chambers and ports arranged in the manner specified, it will be readily apparent that by properly manipulating the valve the engine can be run in either direction, as desired, and the ports leading to the cylinder can be throttled. The inlet-chamber 29 has a threaded opening 36 in its side and a similar opening 37 in its end. Thus the pipe 38, leading from the source of motive fluid, can be connected in either of said openings, whereby the connections can be made as may be more convenient, owing to the particular position in which the drill is being worked, and the opening not receiving said pipe can be closed by a screw-plug 39.

Open seats 40 are formed in the inner faces of the circumferential plates of the piston, and each of said seats extends throughout the length of the piston. Rock-shafts 41 rest in said seats and extend across the piston and project beyond what may be termed the "forward" end of the same into the chamber 4, arms 42, 43, and 44 being formed integral with each of said shafts. The arm 42 is at substantially the point of its shaft which lies in the longitudinal center of the piston, and blocks 45, having semicircular seats in their outer faces, lie over the said shafts and extend between the portions of the piston adjacent said shafts and suitable faces 46 upon the webs 21, one of said blocks lying upon each side of an arm 42. Longitudinally-extending screws 47 engage both a block and its inner seat in order to firmly hold the blocks in position. Each arm 42 extends through and is operable in a slot 23 of an appropriate web and has in its free end an elongated slot 48, which receives a pin 49 upon one of the piston-heads 50. Thus the piston-heads being connected to the rock-shafts as specified rocking of said shafts produces reciprocation of said piston-heads in a well-understood manner.

Suitably mounted to rotate concentrically with the shaft 10 is a plate 51, which has oppositely-extending radial arms, and each of said arms is provided with a seat for the end of one of the before-mentioned rock-shafts 40, whereby the projecting ends of the rock-shafts are supported and bending of the shafts is guarded against. This plate 51 can be conveniently mounted upon a boss 52, which extends inwardly from the head 6 to produce a stuffing-box for the said shaft 10, and said plate abuts against the inner face of the said head 6, whereby the arms 43 and 44 upon the rock-shafts lie intermediate the said plate and the adjacent end of the piston.

Each of said rock-arms 43 and 44 carries at its outer or free end a roller 53, the rollers upon the arms 43 traveling upon a cam-track 54 and the rollers upon the arms 44 traveling upon a cam-track 55. The inner faces of these tracks upon which the rollers travel are circumferentially displaced with respect to each other, whereby as the piston rotates, and thus carries the rock-shafts and their roller-carrying arms in a circle, the rollers follow the said cam-faces and the rock-shafts are rocked in a well-understood manner, this movement of the shafts serving to reciprocate the piston-heads in order to cause them to properly move with respect to the abutment and the block in which said abutment is seated.

The cam-rings 54 and 55 extend around the rock-shafts and their rock-arms and outside of the same, their peripheries being preferably

circular, whereby they can be readily slipped into and out of the chamber 4 from the end thereof, and the casing of the said chamber is provided with interior shoulders 56, against which the respective rings bear when they are forced home. The inner end of the outer shoulder—*i. e.*, the end toward the center of the chamber—being in longitudinal alinement with or outside of the outer end of the inner shoulder and the rings being of correspondingly different diameters, the manner of inserting and removing the said rings will be apparent. Preferably each ring is provided with a recess 57 in its periphery, and corresponding lugs (or a single lug of different heights) 58 are formed upon the main casing and enter said respective recesses when the rings are in place, said lugs or key-ribs and recesses serving to hold the rings against circumferential displacement and also serving as guides in setting the rings. Manifestly the cam-tracks could be made integral with the main casing; but I prefer to employ the rings as just described.

A plate 59, having its periphery in the form of a double cam, as shown in Fig. 5, is suitably formed upon or secured to the piston to rotate therewith, and I have here shown this plate as seated in a groove 60, formed in the end of the piston from which the shaft 9 extends, said plate extending over but not being seated upon the outer periphery of the annular wall 24. Pivoted upon a pin 61, secured to the head 5, is a lever 62, which has rollers 63 pivotally supported upon opposite sides of the said pin, said rollers bearing upon and coöperating with the respective cams. The valve-stem 64 extends beyond the casing and has a non-circular portion 65, the end of the stem beyond said non-circular portion being made circular, as shown at 66. Slidably fitting upon said non-circular portion of the valve-stem is a plate 67, which is provided with lugs or projections 68, while upon the circular end of the valve-stem is a plate 69, provided with recesses 70, adapted to receive the said lugs or projections. The parts just described constitute a clutch mechanism, and the plate 67 is held in yielding engagement with the other clutch member by means of a spring 71. A cap or sleeve 72 is secured to the plate 67 to move therewith and extends about the end of the valve-stem and houses the plate 69, said sleeve being provided with a cut-away portion to permit the projection of the crank-arm 73, which extends from the plate 69. This crank-arm is connected to the lever 62 by means of a link 74.

Normally the spring 71 forces the plates of the clutch member into engagement with each other, and therefore as the plate 69 is rocked by the lever 62 the valve is correspondingly oscillated. If it is desired to reverse the action of the engine or to throttle the same, the attendant can force the sleeve or cap 72 inwardly against the action of the spring 71, thus carrying the projections 68 out of the recesses 70 and breaking the connection between the plates of the clutch. By turning the cap or sleeve the valve can be brought into any desired position, and when the sleeve is released the plate 67 will merely be advanced against the solid portion of the plate 69, so that rocking the lever 62 will serve only to cause the plate 69 to idly oscillate upon the rounded end of the valve-stem. When the parts are in the positions last indicated, the valve is in such position as to connect the inlet-port 29 with the port 35, while the port 34 is connected with the exhaust-port 30. During the reverse rotation of the piston the valve does not oscillate, the plate 67 being merely lightly pressed against the solid portion of the plate 69 by the spring 71. Of course the clutch members are again connected and the valve thus operatively connected with the lever 62 by forcing the cap inwardly and turning the same sufficiently to bring the projections 68 into position to register with the recesses 70. It sometimes happens that the engine stops with its valve-operating cams in such position that the steam-port is closed by the valve. Should such be the case, the valve can be positively moved to open the port, and thus start the engine by manipulating the cap or sleeve 72, as above indicated.

The inlet-pipe 38 for the motive fluid has its end seated in a plug 75, which is provided with exterior threads adapted to engage the threads of the openings 36, leading to the inlet-chamber 29. The plug 75 has a head 76, which is exteriorly threaded, and secured upon said head and extending about the inlet-pipe 38 is a cylindrical casing 77, whose end opposite that closed by the head 76 is closed by a screw-cap 78, which is perforated to permit passage of the pipe 38. The portion of the pipe 38 beyond the casing 77 is provided with two peripheral openings 79, and a block 80 is seated in the pipe intermediate the said openings, and thus closes the direct passage through the pipe. Rotatably mounted between the head 78 and a suitable set-nut or other corresponding member 81 is a sleeve 82, which is adapted to be grasped by the operator, and said sleeve is provided with a recess or channel 83, which when the sleeve is properly positioned establishes communication between the openings or ports 79 in the inlet-pipe. The inlet-pipe and the casing and sleeve form a handle by means of which the machine can be controlled, and the sleeve 82 serves as a throttle-valve, it being only necessary for the operator to turn this sleeve in order to either cut off the flow of motive fluid or to permit such flow.

The portion of the inlet-pipe surrounded by the casing 77 is provided with suitable perforations or openings 84, and the space between the inlet-pipe and casing and the

head 76 and cap 78 forms an oil-cup, the oil being adapted to be sucked through the perforations 84 by the inflowing motive fluid and such oil being carried to the valve and the piston for lubricating the parts in a manner which will at once be apparent. A block 85 is sleeved upon the pipe 38 and is normally forced against the cap 78 by means of a spring 86, bearing between the said block and some suitable abutment 87, said block being provided with passages 88, which extend from the periphery of the block and register with the perforations 84 when the block is in normal projected position. The end of the sleeve 82 adjacent the cap 78 is provided with a cam-surface 89, which coöperates with a pin or other projection 90, extending from the said block. The cam and pin are so related that when the sleeve 82 is turned to establish communication between the openings 79, and thus permit the inflow of motive fluid, the cam permits the block to be fully projected and have its passages 88 in alinement with the oil-perforations 84; but when the sleeve is turned to cut off communication between the openings 79 the cam-surface forces the block out of the position it has previously occupied and carries the passages 88 out of alinement with the oil-perforations, the solid portion of the block sliding over said perforations, and thus closing the same. Therefore whenever motive fluid is flowing through the inlet-pipe the oil can be drawn into such pipe for the purpose of lubricating the parts of the machine; but as soon as the flow of motive fluid ceases the oil-perforations are closed, and there is therefore no chance for the oil to needlessly flow into the inlet-pipe, and thus waste or cause the parts of the machine to become gummed.

I am aware that many minor changes in the construction, arrangement, and combination of the several parts of my device can be made and substituted for those herein shown and described without in the least departing from the nature and principle of my invention.

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

1. In a rotary engine or the like, a reciprocatory member, a rock-shaft support, a rock-shaft mounted thereupon, means for causing rotation of said support, connection between said rock-shaft and said reciprocatory member, arms extending in different directions from said rock-shaft, and cam-tracks with which said arms respectively engage, said cam-tracks being outside of and about said arms; substantially as described.

2. In a rotary engine or the like, a piston, a sliding piston-head, a rock-shaft mounted in a suitable member, means for causing rotation of said member, connection between said rock-shaft and said piston-head, arms oppositely extending from said rock-shaft, and cam-tracks with which said arms respectively engage, said cam-tracks being outside of and about said arms; substantially as described.

3. In a rotary engine or the like, a casing, an insertible cam-ring inserted therein and having substantially its entire periphery engaging the inner face of said casing, said ring having an interior cam-face, and a part coöperating with said cam-face; substantially as described.

4. In a rotary engine or the like, a piston having an open seat therein, a shaft seated therein, and a member extending over said shaft and holding the same in said seat; substantially as described.

5. In a rotary engine or the like, a piston having an open seat therein, a shaft seated therein and having an arm thereon, and blocks secured upon said piston on opposite sides of said arm and holding said shaft in said seat; substantially as described.

6. In a rotary engine or the like, a piston having a circumferential portion provided with an open seat upon its inner circumference, a shaft in said seat, and a block over said shaft and held between said circumferential portion and a suitable other portion of said piston; substantially as described.

7. In a rotary engine or the like, a piston, a movable piston-head, a rock-shaft, a rock-arm integral with said shaft, connection between said arm and said piston-head, and cam-operated rock-arms also integral with said shaft; substantially as described.

8. In a mechanism of the character indicated, a valve, two cam-surfaces which are circumferentially displaced with relation to each other, a lever having members which simultaneously engage said respective surfaces, whereby said lever is rocked, and operative connection between said lever and said valve; substantially as described.

9. In a rotary engine or the like, a casing having a head, a wall projecting therefrom, a piston, a shaft thereon seated in the space inclosed by said wall, a cam upon said piston and extending over said wall, a valve, and operative connection between said valve and said cam; substantially as described.

10. In a mechanism of the character indicated, a rotatable double cam, means for rotating the same, a valve, a pivoted lever whose arms simultaneously engage the respective cam-surfaces, and a link connecting an arm of said lever and said valve; substantially as described.

11. In a rotary engine or the like, a piston, a movable piston-head, a rock-shaft, connection between said shaft and said piston-head, and a cam-operated rock-arm integral with said shaft; substantially as described.

12. In a rotary engine or the like, a piston having a slot extending therethrough and pro-

vided with integral shafts projecting from the piston ends, piston-heads slidable in said slot, rock-shafts seated in said piston, connection between said respective rock-shafts and said piston-heads, integral arms upon said rock-shafts, and a cam coöperating with said arms; substantially as described.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 18th day of July, 1902.

JOHN W. PICKEL.

Witnesses:

JOHN V. HAEFNER,

J. V. HAEFNER, Jr.