No. 610,161. Patented Sept. 6, 1898.

H. I. ARNOLD.

ROTARY ENGINE.

(Application filed Oct. 14, 1897.)

(No Model.) 3 Sheets—Sheet 1.

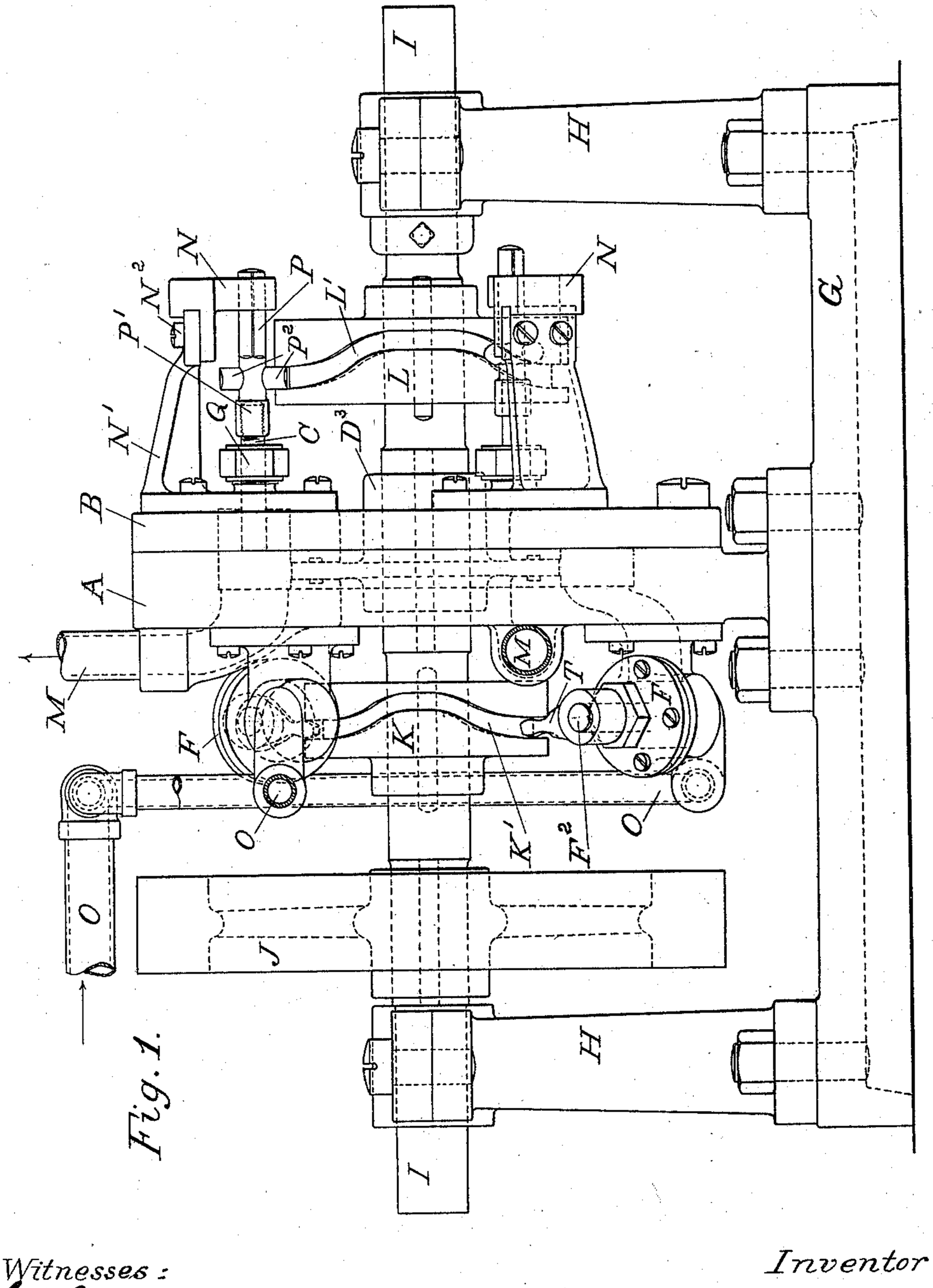

Fig. 1.

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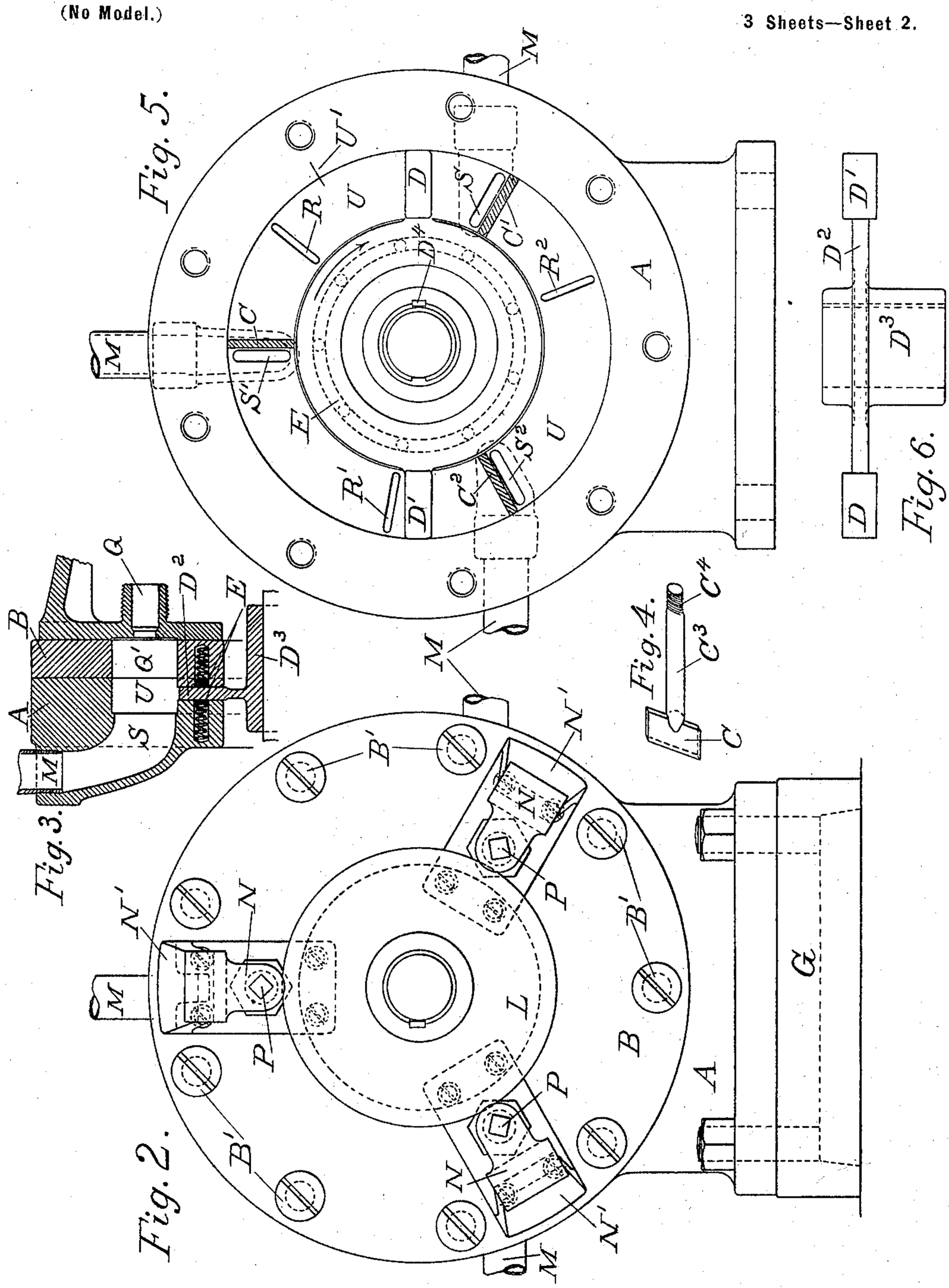

Fig. 5.

Fig. 6.

Fig. 4.

Fig. 3.

Fig. 2.

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Fig. 7.

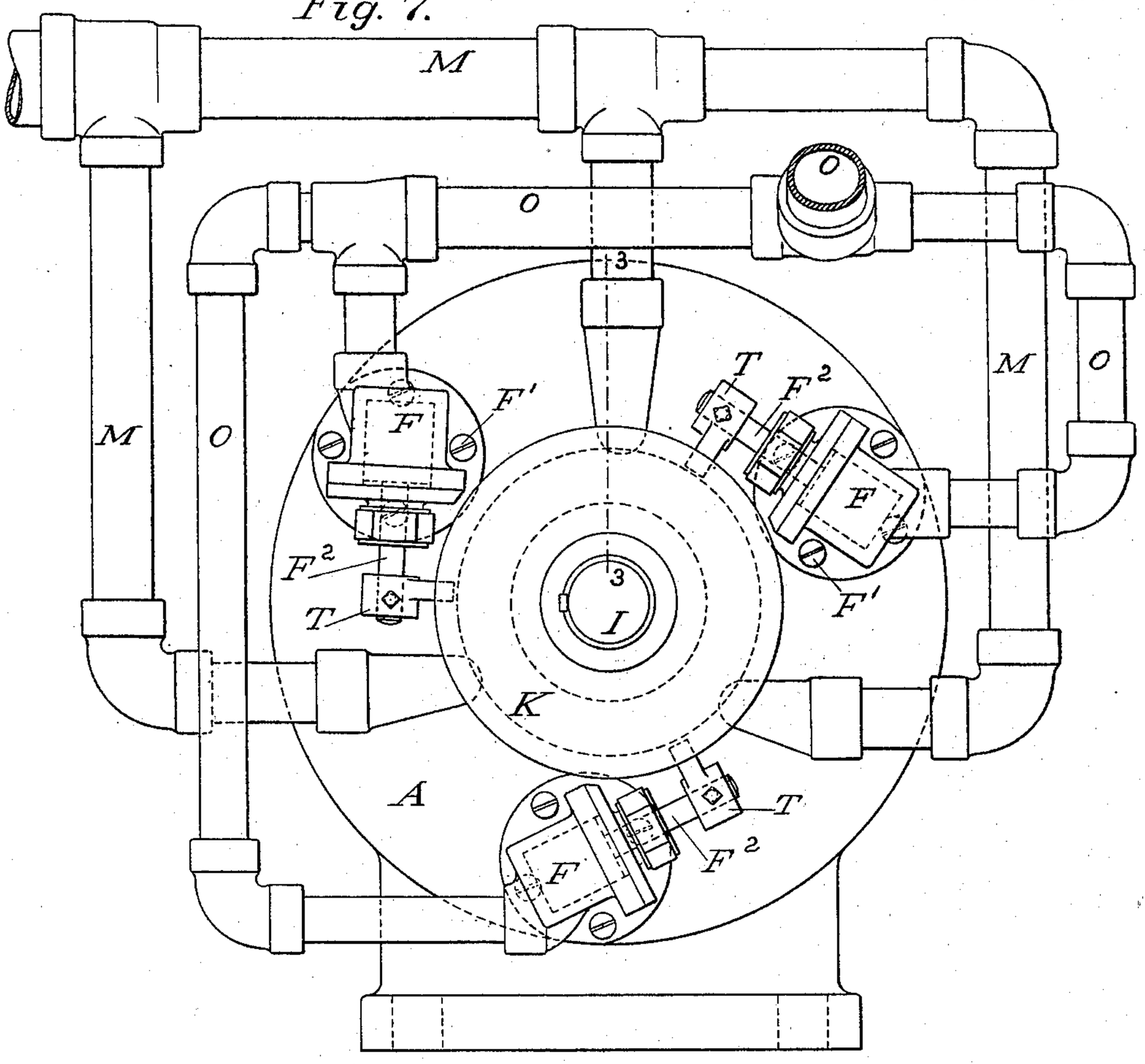


Fig. 8.

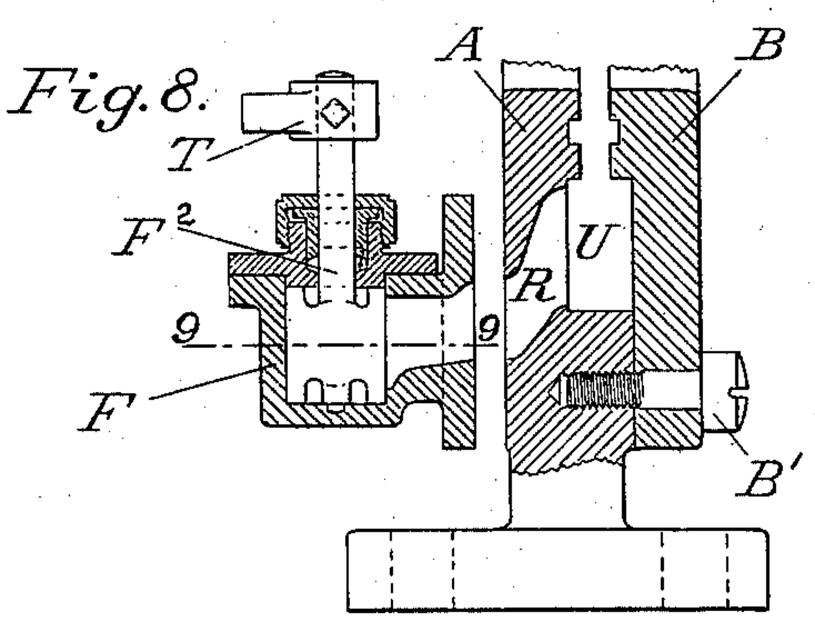
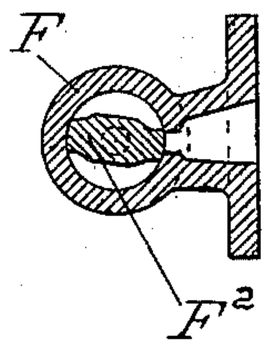


Fig. 9.



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UNITED STATES PATENT OFFICE.

HARRY I. ARNOLD, OF COLUMBIA, TENNESSEE, ASSIGNOR TO KATYE W. ARNOLD, OF SAME PLACE, AND ALFRED CHRISTIANSEN AND MARY L. ARNOLD, OF WATERVLIET, NEW YORK.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 610,161, dated September 6, 1898.

Application filed October 14, 1897. Serial No. 655,189. (No model.)

To all whom it may concern:

Be it known that I, HARRY ISAAC ARNOLD, a citizen of the United States, residing at Columbia, county of Maury, and State of Tennessee, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

The invention relates to such improvements; and it consists of the novel construction and combination of parts hereinafter described and subsequently claimed.

Reference may be had to the accompanying drawings, and the letters of reference marked thereon, which form a part of this specification.

Similar letters refer to similar parts in the several figures therein.

Figure 1 of the drawings is a side elevation of my improved engine. Fig. 2 is an end elevation of the same with the bearing of the main shaft omitted from the right-hand side as seen in Fig. 1. Fig. 3 is a vertical cross-section, taken on the broken line 3 3 in Fig. 7, showing an eduction pipe and port, the piston-chamber, stuffing-box for a gate-stem, and the packing mechanism on opposite sides of the piston-disk. Fig. 4 is an isometrical perspective of one of the resistance gates or abutments. Fig. 5 is an elevation of the main case or cylinder A, with the cover B and all the parts to the right of the cover as seen in Fig. 1 removed. Fig. 6 is an edge view of the piston-disk with its hub-sleeve and pistons. Fig. 7 is an end elevation of the engine with the bearings of the main shaft and the fly-wheel omitted and viewed from the left-hand side as seen in Fig. 1. Fig. 8 is a central longitudinal section of an induction-valve detached and a radial cross-section of a portion of the cylinder to which the valve is to be attached. Fig. 9 is a cross-section of the valve-case and valve-plug, taken on the broken line 9 9 in Fig. 8.

Referring to the drawings, A is the main case or cylinder, bolted to the base G, and B is the cylinder-cover, secured to the cylinder by screws B′.

The motor-shaft I passes centrally through the cylinder and cover and is provided with end bearings in the uprights H, bolted to the base. The shaft is provided with a fixed wheel J, which may serve as a fly-wheel or driving-pulley, or both, and with the cam-wheels K and L, for operating the induction-valves and resistance-gates, respectively, as will be hereinafter more fully described. The motor-shaft also supports within the cylinder the pistons D D′, which project radially from the piston-disk D^2, having a sleeve D^3, which fits the shaft and is fixed thereon, as by the key D^4.

The cylinder-case is provided with an annular groove or chamber U, adapted to receive and fit the pistons, also with three induction-ports R, R′, and R^2, opening into the piston-chamber, and three eduction-ports S, S′, and S^2, leading from the piston-chamber to the atmosphere.

The supply of steam or other expansive fluid to the induction-ports is controlled by the valves F, secured to the outside of the case, as by screws F′, and located within the supply-pipes O O. The valve plug and stem F^2 are operated by the cam-followers T, fixed upon the stem and following in the groove K′ of the cam-wheel K.

The eduction-ports S are always open to the atmosphere and exhaust through the pipes M. The escape of steam through the eduction-ports is controlled by the resistance-gates C, C′, and C^2, as will be explained after describing their mechanical operation.

The resistance-gates have a reciprocating slide movement and comprise a blade which fits the piston-chamber of the cylinder, a stem, and an actuating cam-follower adjustable longitudinally of the stem.

One part C^3 of the stem fixed to and supporting the blade is made smooth along its middle portion to reciprocate in the stuffing-box Q and is provided on its outer end with screw-threads C^4, by which it is adjustably connected with the other part P of the stem, which part is provided with an interiorly-threaded socket P′, adapted to receive and fit the screw-threads C^4, the part P being provided with one or more cam-followers P^2, adapted to follow in the groove L′ of the cam L, and thereby actuate the gate. The part P is adapted to reciprocate in a bearing in the bracket-hanger N, secured to some fixed support, as the bracket-arm N′, projecting

from the cylinder-cover. That portion of stem P which moves in its bearing is rectangular in cross-sectional form and has its bearings correspondingly formed, whereby that part of the stem is prevented from acquiring a rotary movement.

The object of the longitudinal adjustment is to control the reciprocating movements of the resistance-gate and provide for readjustment in case of wear. For example, should the cam-follower wear away to such an extent as to fail to tightly close the gate against the inner vertical wall of the piston-chamber it would only be necessary to detach hanger N by removing bolts N^2, slip it off from the stem P, and partially rotate that part of the stem until the screw-threaded portions of the two stem parts lengthened the distance between the gate-blade and the gate-actuating follower sufficiently to compensate for the wear.

The exactitude of adjustment is only limited by the pitch of the threads on the stem parts and the number of follower-stems projecting from stem P and the number of plane sides on that portion which travels in corresponding bearings in the hanger.

In Fig. 3 the gate has been detached, and the part marked Q shows the interior of the stuffing-box, through which the gate-stem C^3 reciprocates, and Q′ the space occupied by the gate-blade when open.

To close the gate, the blade is forced into the space marked U, which is the piston-chamber, and is located just one side of the eduction-port S.

The operation of the engine is as follows: The parts being in the position shown in Fig. 5, that portion of the piston-chamber located between the piston D and the gate C is filled with steam under pressure, which acts upon the piston until it reaches the eduction-port S and opens that portion of the chamber to that port. While the piston D is passing from its position shown in Fig. 5 to such port S, the gate C′, acted upon by cam L, has been withdrawn from the chamber into its recess in the cylinder-cover, leaving the chamber clear for the passage of the piston; but before piston D has passed port S and ceased to be acted upon by the steam the piston D′ has passed the induction-port R′, the gate C^2 has been closed by cam L, and the induction-port R′ has been opened by cam K to admit the expansive fluid into that portion of the piston-chamber located between the piston D′ and the resistance-gate C^2. Then just before the piston D′ reaches the eduction-port S′ the piston D has passed induction-port R^2, gate C′ has been closed, and port R^2 has been opened, so that piston D is again acted upon while the piston D′ is traveling from port S′ past port R, and so on past the successive inlet and discharge ports, one of the pistons always being subjected to the steam-pressure so long as steam is admitted to the common feed-pipe O.

It will be observed that in my improved construction the resistance-gates, sometimes called "abutments," are moved only when the spaces in the piston-chamber on the opposite sides of the gates are open to the atmosphere through the respective eduction-ports, and that the gates are not subject to steam-pressure on either side while they are in motion, whereby they can be easily moved without loss of power or excessive wear, which would result if they were subject to the steam-pressure while in motion.

It is likewise obvious that the cam K can be so formed and adjusted upon the drive-shaft as to operate the valves F to cut off the steam while the pistons are under pressure at any desired point between the appropriate induction and eduction ports, whereby the expansive force of the steam can be more fully utilized, the same as in reciprocating engines. For example, if the supply of steam had been cut off when the piston D arrived at the line U′ in Fig. 5 the admitted steam would approximately double in volume when the piston reached the next eduction-port S, thereby utilizing after the cut off the expansive force of the steam.

To prevent the loss of steam from the piston groove or chamber along the sides of the piston-disk, I provide two metallic packing-rings E, inserted in annular grooves in the case, one on each of the opposite sides of the disk, and hold them against the disk with a series of small coil-springs E′, inserted in receiving-holes formed in the case, as shown by solid lines in Fig. 3 and by dotted lines in Fig. 5.

It is obvious that the cross-sectional form of the piston-chamber and pistons may be changed as desired. The power of the engine can be greatly increased by increasing the radial length of the pistons without changing their width, and consequently without changing the traveling distance of the resistance-gates when they move in a direction parallel with the main shaft; also, that the number of pistons and ports may be increased when desired.

I make use of at least three separate induction and eduction ports and two pistons, which construction permits of maintaining the pistons under pressure alternately and the piston-disk and main shaft continuously and also permits the gates to be operated successively and while they are severally open on one side to the atmosphere and wholly cut off on the opposite side from the steam-pressure. In operating the gates to open them the piston-chamber is open from both the opposite sides of a retreating gate to the atmosphere; but in closing them the piston-chamber is opened from one of the opposite sides of the gate to the atmosphere, and the other side of the gate is wholly cut off from the steam-pressure, whereby the piston-chamber is divided into three sections, which are alternately and successively opened and closed to the atmosphere by the pistons, and the gate-oper-

ating mechanism is so timed as to close the gates successively by forcing each gate into a section of the chamber which is open to the atmosphere and wholly cut off from the steam-pressure, thereby permitting the gates to project from the chamber to the atmosphere, where they can be operated by exterior mechanism, avoiding contact with and wear upon the pistons.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, a cylinder having an annular piston-chamber with a plurality of alternating induction and eduction ports; in combination with a retreating slide-gate, projecting exteriorly of the chamber to the atmosphere, and located in the chamber between two eduction-ports each open to the gate and the atmosphere while the gate is being withdrawn and exteriorly-located gate-operating mechanism, whereby the gate is withdrawn from the chamber longitudinally of the shaft without contact with the piston and while the chamber on both the opposite sides of the gate is open to the atmosphere, substantially as described.

2. In a rotary engine, the combination with a cylinder having an annular piston-chamber with three valved induction-ports and three open eduction-ports; of two oppositely-disposed pistons; and three slide-gates movable in and out of the piston-chamber, each projecting exteriorly of the chamber to the atmosphere, whereby the chamber is divided into three sections adapted to be alternately opened and closed to the atmosphere by the pistons; exteriorly-located mechanism for forcing the gates longitudinally of the shaft successively in and out of an open section of the piston-chamber; and means for operating the valves controlling the induction-ports, substantially as described.

In testimony whereof I have hereunto set my hand this 4th day of October, 1897.

H. I. ARNOLD.

Witnesses:

ALFRED CHRISTIANSEN, Jr.,

FRANK C. CURTIS.