(No Model.) 4 Sheets—Sheet 1.

J. J. ST. LAWRENCE.

ROTARY ENGINE.

No. 343,206. Patented June 8, 1886.

Fig. 1

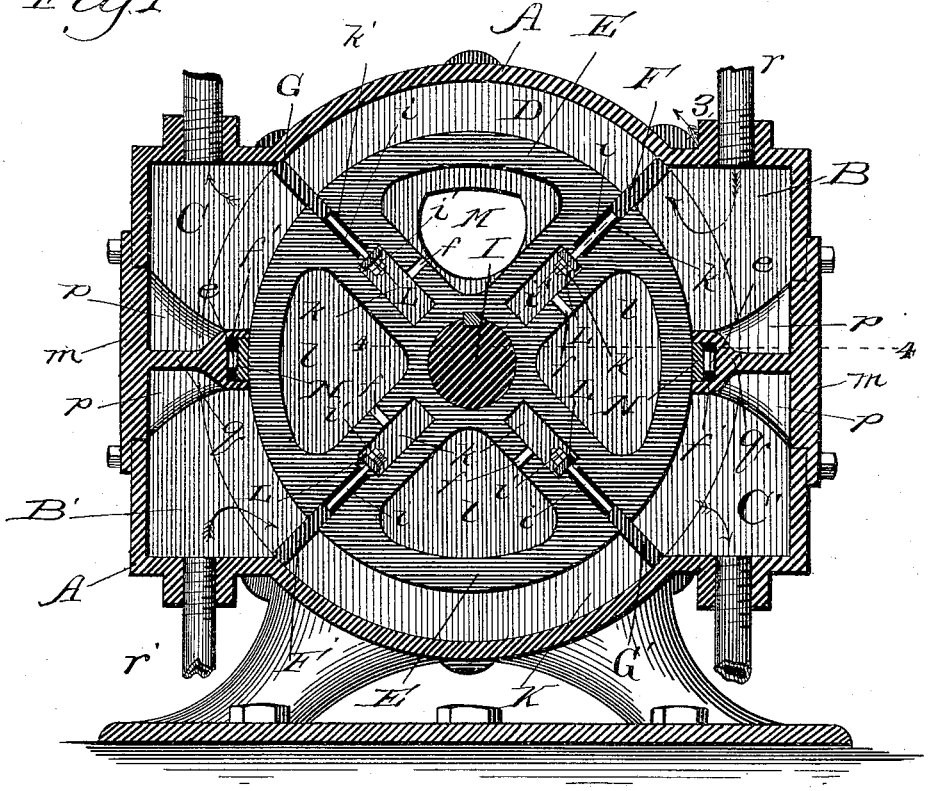

Fig. 2

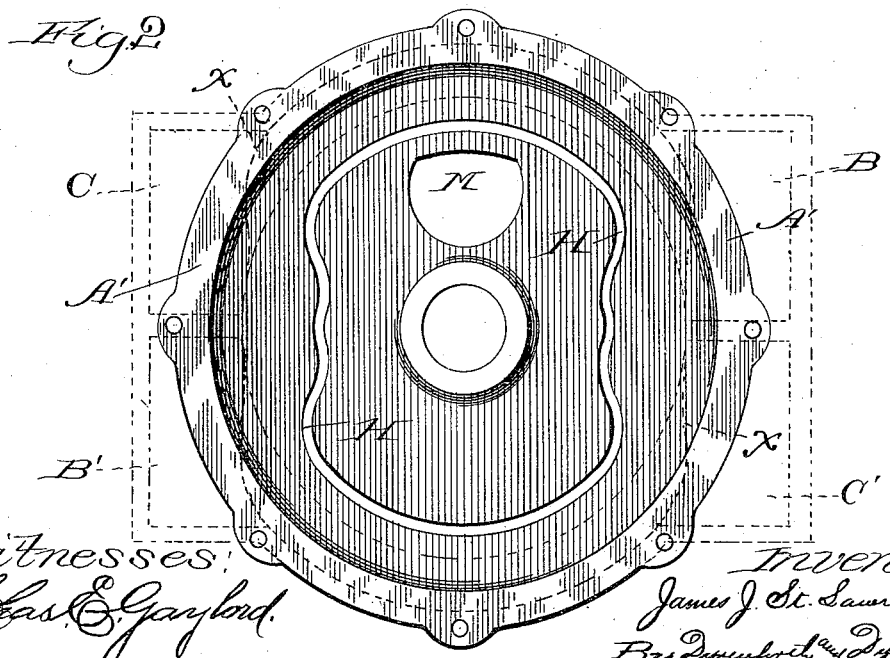

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Fig. 3.

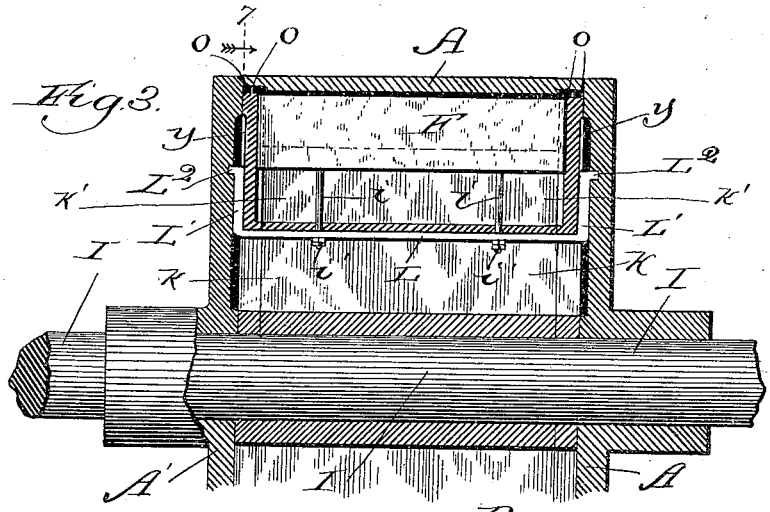

Fig. 4.

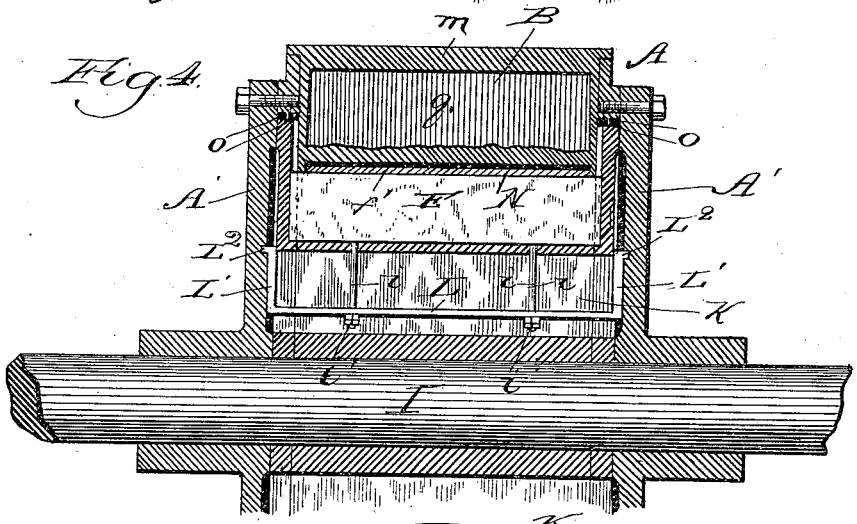

Fig. 5.

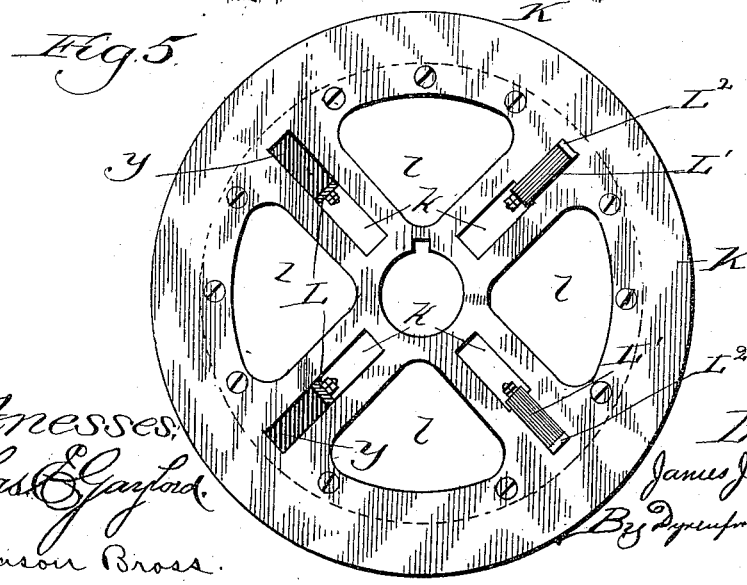

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Fig. 6.

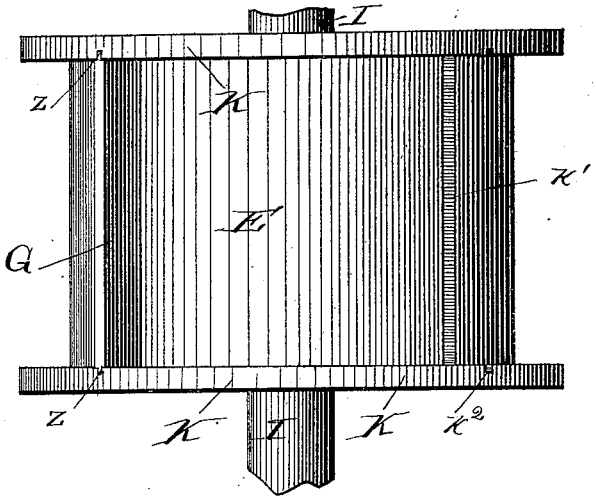


Fig. 7

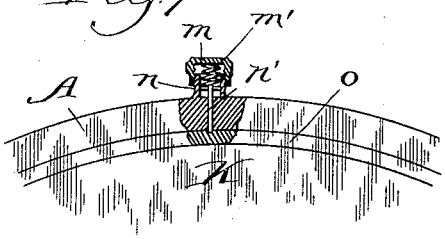


Fig. 8.

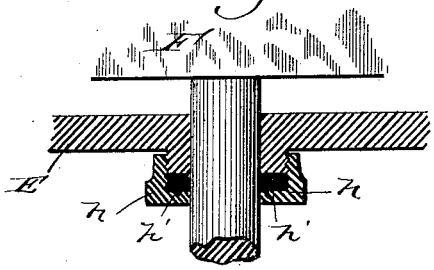
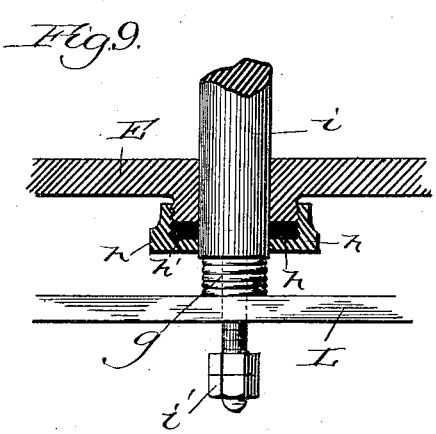
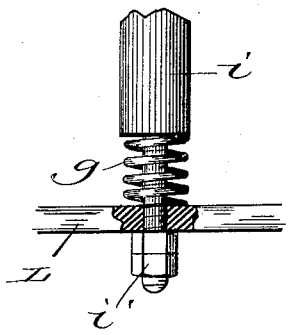


Fig. 9.





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J. J. ST. LAWRENCE.

ROTARY ENGINE.

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Fig. 10.

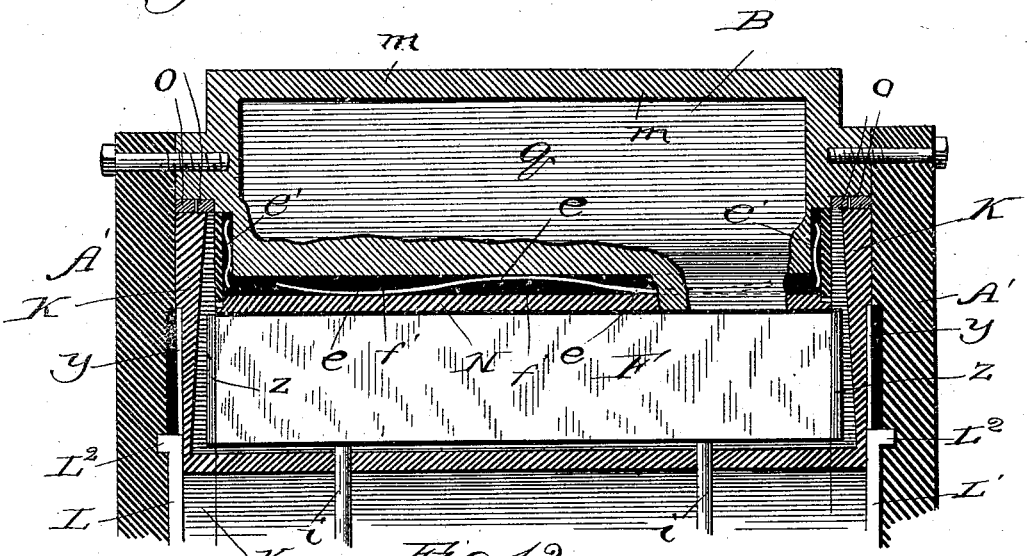


Fig. 11.

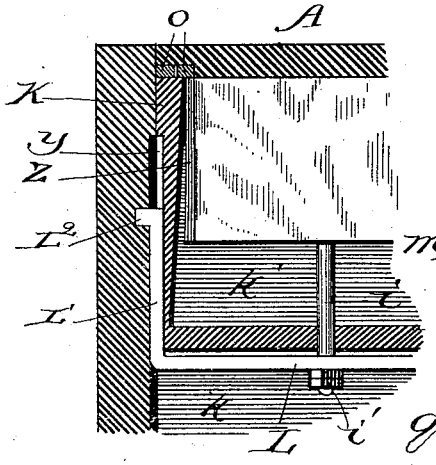
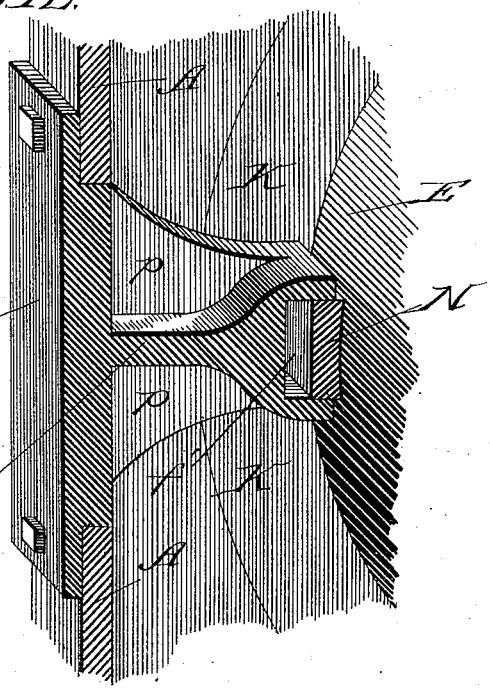


Fig. 12.



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UNITED STATES PATENT OFFICE.

JAMES J. ST. LAWRENCE, OF CHICAGO, ILLINOIS.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 343,206, dated June 8, 1886.

Application filed November 10, 1885. Serial No. 182,333. (No model.)

To all whom it may concern:

Be it known that I, JAMES J. ST. LAWRENCE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and Improved Rotary Engine; and I hereby declare the following to be a full, clear, and exact description of the same.

The generally ephemeral character of engines of the foregoing description hitherto invented appears to be due, even when they are well constructed, entirely to mechanical difficulties, which may be summed up in the statement that, as it is believed, so far no means have been found of packing the pistons so that they shall work without excessive friction, be permanently steam-tight, and durable.

It is my object to afford a rotary engine, by the construction of which these mechanical difficulties shall be overcome in a degree sufficient to render the device operative, practicable, and durable.

To this end my invention consists in the general construction of my improved machine; and it also consists in certain details of construction and combinations of parts, all as hereinafter more fully set forth and claimed.

Referring to the drawings, Figure 1 is a transverse section of a rotary engine of my improved construction, having the steam and the exhaust pipes broken away. Fig. 2 represents in elevation the inner side of one cylinder-head, (both cylinder-heads, however, being constructed alike,) showing the cam-slot which controls the movement of the pistons. Fig. 3 shows a sectional view taken on the line 3 3 of Fig. 1, and viewed in the direction of the arrows; Fig. 4, a sectional plan view taken on the line 4 4 of Fig. 1; Fig. 5, an end view of the piston-wheel, which is indicated by the dotted lines in the figure, the full lines representing the disk or head, one being provided on each end of the wheel, and two of the piston-actuating bars being shown in section, the horizontally-angular portions being removed to show the recesses or guides in which the upright angular portions of the piston-actuating bars reciprocate; Fig. 6, a plan view of the piston-wheel with the shaft broken away at its ends, and having one sliding piston removed to show the recesses in which it works; Fig. 7, a broken view of a detail taken on the line 7 7 of Fig. 3; Fig. 8, a broken sectional view enlarged and showing the compensating mechanism for each piston with the spring distended; Fig. 9, a sectional view of the same, showing the spring compressed; Fig. 10, an enlarged sectional view similar to that shown in Fig. 3, but showing details incapable of representation on such figure owing to its size, and having parts broken away to permit the display; Fig. 11, a sectional view of a portion of the device as represented in Fig. 4, enlarged and showing the construction of certain details; and Fig. 12, a sectional view, in perspective, showing the construction of the walls separating the steam and exhaust chambers and the manner of adjusting the packing-blocks.

My construction involves a shell, A, suitably supported, as shown, cylindrical in form as to its central portion, but provided with lateral divided chambers, forming steam chests or chambers B and B′, and exhaust chests or chambers C and C′, which chambers open into the cylindrical portion D, and a piston-wheel, E, of particular construction, carrying pistons F and F′ and G and G′, having a reciprocating motion to extend in affording a closed steam-chamber and retract to permit the exhaust, which reciprocating operations are effected by suitable mechanism, hereinafter described, guided in the cam grooves or slots H, Fig. 2, provided on the inner faces of the cylinder-heads A′.

The detailed construction of my device will be best understood by a description of the various parts forming it in connection with a description of the operation of such parts, which is as follows:

The piston-wheel E is rotated upon its shaft I, which is journaled in opposite sides of the shell A, by means of steam-pressure introduced through pipes r and r', leading into the chambers B and B′, and impinging against the pistons F and F′. The chambers B and C′ and C and B′ are respectively separated from each other by a partition, q, having inwardly-slanting side walls, all formed on plates M, bolted to cover openings provided to receive them in the shell A, whereby they may be removed to renew the packing-blocks N, inserted into recesses f', provided in the forward ends of the partitions q to receive them, and springs e, which force the packing-blocks against the

surface of the piston-wheel, which, really, with the dividing-walls *p q* or packing-blocks, forms the steam and exhaust chambers.

The piston-wheel E is in the form of a spool, narrower in diameter than the cylindrical portion of the shell A to leave a space between the adjacent surfaces of the two, which is alternately divided by the pistons F and F′ and G and G′ into steam-tight chambers and open chambers communicating with the exhausts C and C′, and the heads K on the opposite ends of the piston-wheel (being secured in position by countersunk screws, as shown in Fig. 5) are of a diameter to extend into contact with packing-rings *o*, two of which are placed side by side inside the cylinder A, toward each end of the same, where it is recessed to receive them, the flange portions of the heads K fitting snugly against the rings, and the flat inner surfaces of these flange portions are in contact with packing-blocks, adjusted like the packing-blocks N in the ends of the partitions *q*, and having a tendency to lateral or outward pressure by means of springs *e*′.

A device (shown in detail in Fig. 7 of the drawings) serves to tighten each ring against the adjacent head K, as desired. It comprises a thimble, *n*, on the shell, containing a T-rod, *n*′, or pin with a cross-head, as shown, extending through the same and entering at the extremity of the shank, a groove or depression in the ring and a screw-cap, *m*, on the thimble inclosing a spiral spring, *m*′, which rests upon the head of the T-rod, and is compressed or allowed to expand by turning the cap *m*, thus affording a yielding pressure. These devices are placed around the cylinder D alternately, about four being provided for each ring.

The piston-wheel E is provided with openings *l*, extending longitudinally through it to afford the greatest possible lightness of this feature by removing superfluous metal, and between these openings in the web openings *k* are formed, also extending longitudinally through the wheel, and above these are narrower openings, *k*′, radial upon the wheel and extending to the surface of the latter. At their extremities the openings *k*′, where they are formed on the inner sides of the heads K, are beveled outwardly, as clearly shown in Figs. 10 and 11, upon their rear surfaces, and narrower than in the piston-wheel to afford snug fit to the tenons *y* on the reciprocating pistons, hereinafter described. A flat bar, L, is provided in each opening *k*. Its ends extend beyond the same, and are bent to form right angular portions L′, adjacent to the surfaces of the heads K, which are grooved or recessed, as shown at *y*, to receive and guide them, and again bent to afford right-angular portions L^2, which extend into the cam-grooves H, provided on the internal surfaces of the cylinder-heads A′. A piston, F, F′, G, and G′, each in the form of a rectangular oblong metallic bar, having the tenons *y* at its opposite ends, is provided for each recess *k*′, being of a thickness to fit snugly within the same, both as to its main and tenon portions, and is connected with the bar L by means of rods *i*, passing through the latter into the piston and held by lock-nuts *i*′. The opening for each rod *i*, leading from a chamber, *k*, into a chamber, *k*′, is flanged, as shown in Figs. 8 and 9, and provided with an annular cap, *h*, to contain packing *h*′. The rods *i* are reduced in diameter toward their ends nearest the center of the piston-wheel, as clearly shown in Figs. 8 and 9, to afford shoulders for spiral springs *g*, placed between them and the bars L, and serving a purpose hereinafter described, and the rods are extensible upon their reduced portions, which must be separable from them.

From the foregoing it will readily be seen that since the parts L^2 of the bars L, to which the pistons are connected, must in the revolution of the piston-wheel follow the guides afforded by the cam slots H in the cylinder-heads, the pistons F F′ G G′ must reciprocate in conformity with the shape of the cam grooves or slots. This is so formed that with the piston-wheel E in the position represented in Fig. 1, the pistons will be in contact with the inner surface of the cylindrical portion of the shell A, but that by the continued revolution of the piston-wheel, produced by the pressure of steam within the chambers B and B′ against the pistons F and F′, the pistons G and G′ will pass the exhaust-chambers C and C′, allowing the steam confined between the various pistons to exhaust, and as the pistons last specified approach the walls *p q* they are collapsed by the form of the cam grooves or slots H to permit them to pass without being removed from close contact with the packing-blocks N. Of course each pair of pistons F F′ and G G′ performs the piston-function alternately in the revolution of the piston-wheel, and describes the plane illustrated by the dotted line *x* in Fig. 2 of the drawings, remaining while it serves as a piston in close contact with the inner surface of the cylinder A′, and dispensing with the use of packing on the ends of the pistons.

As the frictional wear upon the outer edges of the pistons will reduce the latter in extent of cross-section, the springs *g* are provided, being originally adjusted in compressed condition, as shown in Fig. 9, but insuring by their expansion, with the wearing off of the metal upon the contact edges of the pistons, always the same close contact of the latter with the inner surface of the cylinder A.

Lubrication of the parts is accomplished through a hand-hole, M, in a cylinder-head, A′, or in each, if required, and openings *f*, leading from the openings *l* into the openings or recesses *k*, to permit lubrication of the pistons.

A highly-important feature of my construction consists in the beveled form of the openings K′ at their extremities, as they enable resistance against the extension of the recip-

rocating pistons by the steam-pressure to be overcome by permitting the entrance below the pistons of steam to produce counter-pressure. This is afforded by the entrance of steam underneath the pistons as they descend, the beveled form of the openings *k'* at their ends leaving spaces between the extreme ends of the tenons *y* and rear walls of the ends of such openings, through which spaces the steam may enter underneath the pistons for the purpose named; but these spaces are closed with the reciprocating pistons at or near the position of the piston shown in Fig. 11, owing to their close fit, when extended, within their bearings afforded by the ends of the openings *k'*.

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

1. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the cylinder provided with lateral non-communicating chambers forming with the piston-wheel the exhaust and steam chambers in pairs on opposite sides, substantially as described.

2. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the cylinder provided with lateral chambers forming with the piston-wheel the exhaust and steam chambers, and the reciprocating pistons movable within openings *k'* in the piston-wheel, beveled at their extremities to afford spaces through which to admit steam underneath the pistons, and produce thereby counter-pressure to the steam-supply, substantially as described.

3. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the cylinder provided laterally with removable partition-walls having self-adjusting packing-blocks, and forming with the piston-wheel the exhaust and steam chambers, substantially as described.

4. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the cylinder provided laterally with removable partition-walls having self-adjusting packing-blocks, and forming with the piston-wheel the exhaust and steam chambers, and the reciprocating pistons movable within openings *k'* in the piston-wheel, beveled at their extremities to afford spaces through which to admit steam underneath the pistons, and produce thereby counter-pressure to the steam-supply, substantially as described.

5. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the shell A, having the cylindrical space D and provided with lateral plates secured over openings in the shell, and carrying partition-walls having self-adjusting packing-blocks, and forming with the piston-wheel the exhaust and steam chambers, substantially as described.

6. In a rotary engine having a piston-wheel provided with radially-reciprocating pistons, the shell A, having the cylindrical space D and provided with lateral plates secured over openings in the shell, and carrying partition-walls having self-adjusting packing-blocks, and forming with the piston-wheel the exhaust and steam chambers, and the reciprocating pistons movable within openings *k'* in the piston-wheel, beveled at their extremities to afford spaces through which to admit steam underneath the piston, and produce thereby counter-pressure to the steam-supply, substantially as described.

7. In a rotary engine, the shell A, divided on opposite sides to form with the piston-wheel steam and exhaust chambers, and cylindrical in form toward its central part to constitute the cylinder D, provided with cam grooves or slots H on its heads, and the rotary piston-wheel E, within the shell carrying radially-reciprocating pistons actuated by the cam grooves or slots H, and movable within openings *k'* in the piston-wheel, beveled at their extremities to afford spaces through which to admit steam underneath the pistons, and produce thereby counter-pressure to the steam-supply, substantially as described.

8. In a rotary engine, the rotary piston-wheel E, provided with longitudinal openings *k*, containing bars L, carrying reciprocating pistons F F' G G', and bent toward their opposite extremities to afford projections L^2, and cam grooves or slots H, formed on the cylinder-heads and serving to reciprocate the pistons by contact with the projections L^2, substantially as described, and for the purpose set forth.

9. In a rotary engine, the rotary piston-wheel E, provided with longitudinal openings *k*, containing bars L, carrying reciprocating pistons F F' G G', movable within openings *k'*, beveled at their extremities to afford spaces through which to admit steam underneath the pistons, and produce thereby counter-pressure to the steam-supply, the said bars L being bent toward their opposite extremities to afford projections L^2, and cam grooves or slots H, formed on the cylinder-heads and serving to reciprocate the pistons by contact with the projections L^2, substantially as described.

10. In a rotary engine, the shell A, having the cylindrical space D, having cam grooves or slots H on its heads and containing packing-rings *o*, and provided laterally with removable partition-walls having self-adjusting packing-blocks, a piston-wheel, E, forming with the partition-walls exhaust and steam chambers, and having heads K, provided with longitudinal openings *k*, containing bars L, bent toward their opposite extremities to afford projections L^2 in contact with the cam grooves or slots H, and with openings *k'*, beveled at their extremities and containing pistons F, F', G, and G', connected with the bars L, the whole being constructed and arranged to operate substantially as described.

11. In a rotary engine, the shell A, having the cylindrical space D, having cam grooves or slots H on its heads and containing pack-

ing-rings *o*, and provided laterally with removable partition-walls carrying self-adjusting packing-blocks, a piston-wheel, E, forming with the partition-walls exhaust and steam chambers, and having heads K, provided with longitudinal openings *k*, containing bars L, bent toward their opposite extremities to afford projections L^2 in contact with the cam grooves or slots H, and with openings *k'*, beveled at their extremities and containing pistons F F' G G', connected with the bars L by means of movable rods *i*, provided with springs *g*, the whole being constructed and arranged to operate substantially as described.

12. In a rotary engine, the shell A, having the cylindrical space D, having cam grooves or slots H on its heads and containing packing-rings *o*, having means, substantially as described, upon the cylinder for tightening them with yielding pressure, and provided laterally with removable partition-walls carrying self-adjustable packing-blocks, a piston-wheel, E, forming with the partition-walls exhaust and steam chambers, and having heads K, provided with longitudinal openings *k*, containing bars L, bent toward their opposite extremities to afford projections L^2 in contact with the cam grooves or slots H, and with openings *k'*, beveled at their extremities and containing pistons F F' G G', connected with the bars L by means of rods *i*, provided with springs *g*, the whole being constructed and arranged to operate substantially as set forth.

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