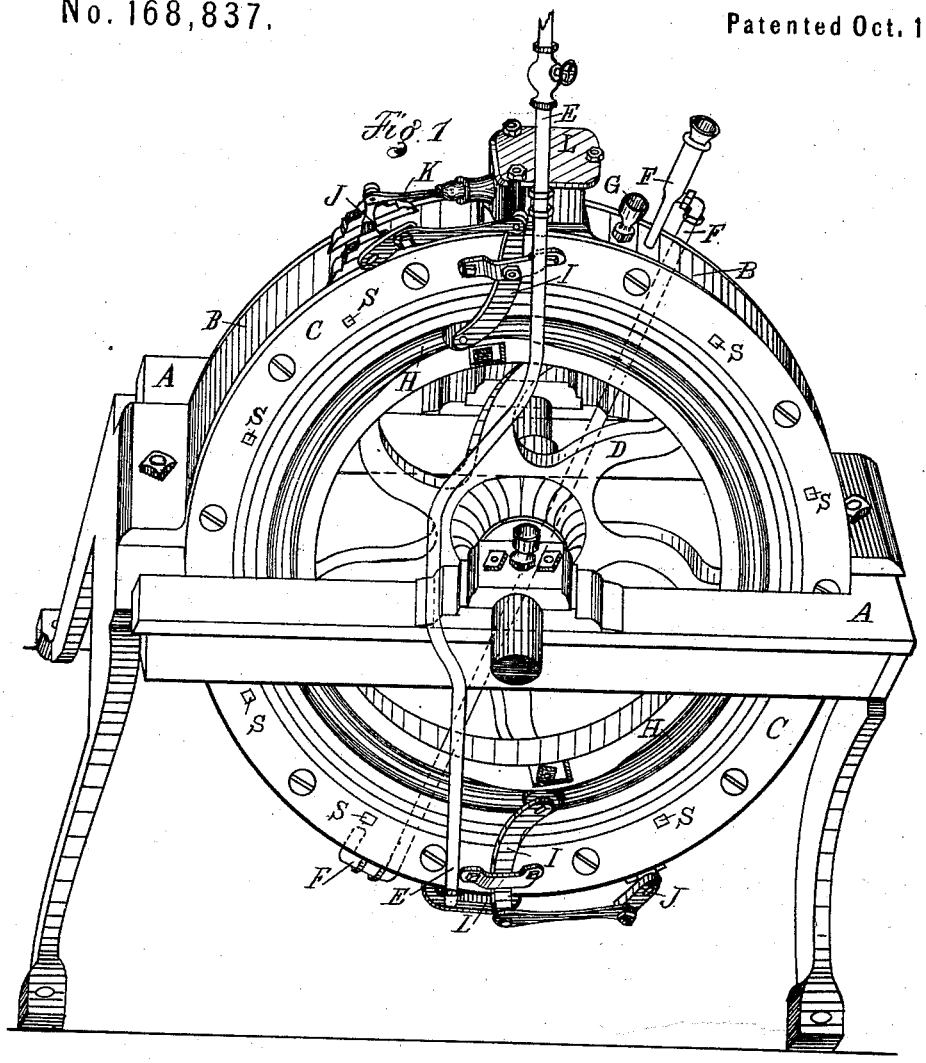
4 Sheets--Sheet 1.

G. D. HARWOOD.

Rotary-Engine.

No. 168,837. Patented Oct. 19, 1875.

Fig. 1



Witnesses

Geo. T. Smallwood Jr.
John Robey Jr.

Inventor.

Geo. D. Harwood
By John J. Halsted,
his Atty.

4 Sheets--Sheet 2.

G. D. HARWOOD.

Rotary-Engine.

No. 168,837. Patented Oct. 19, 1875.

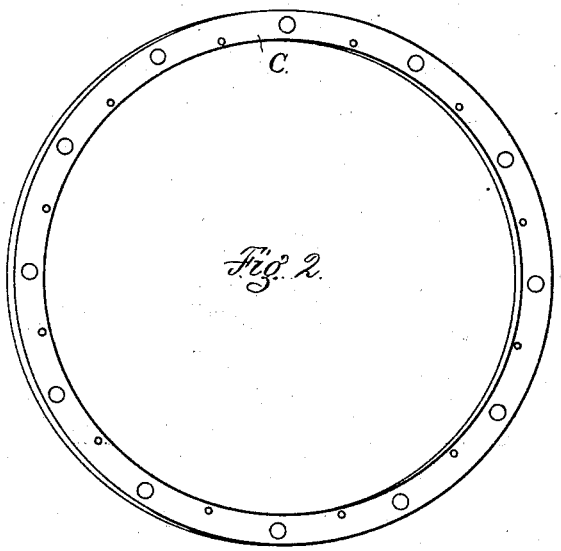


Fig. 2.

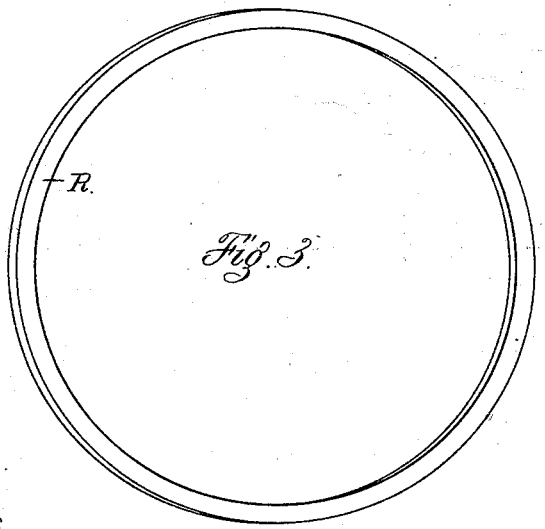


Fig. 3.

Witnesses

Geo. T. Smallwood Jr.
John Robey Jr.

Inventor.

Geo. D. Harwood.
By. John J. Halsted,
his Atty.

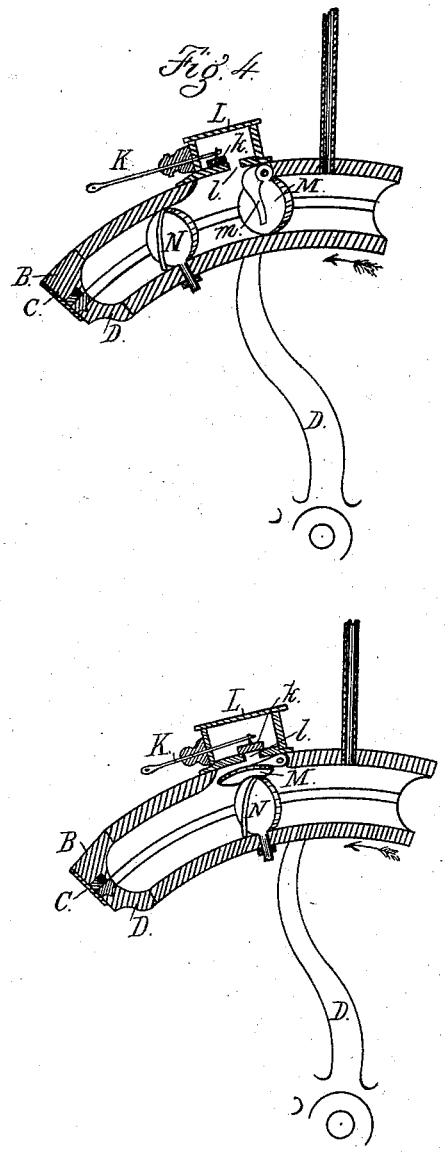
4 Sheets--Sheet 3.

G. D. HARWOOD.

Rotary-Engine.

No. 168,837. Patented Oct. 19, 1875.

Fig. 4.



Witnesses.

Geo. T. Smallwood Jr.
John Roby Jr.

Inventor.

Geo. D. Harwood.
By John J. Halstead,
his Atty.

G. D. HARWOOD.
Rotary-Engine.

No. 168,837. Patented Oct. 19, 1875.

Fig. 6.

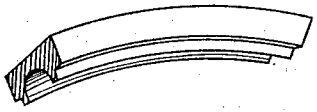


Fig. 7.

Fig. 9.

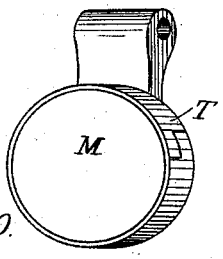


Fig. 5.

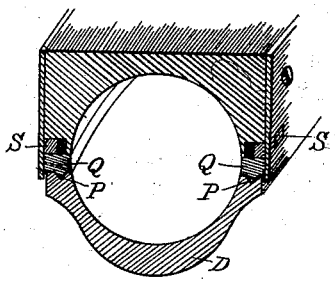


Fig. 8.

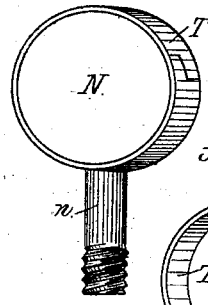


Fig. 10.

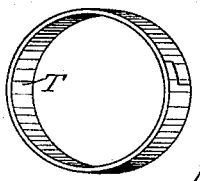
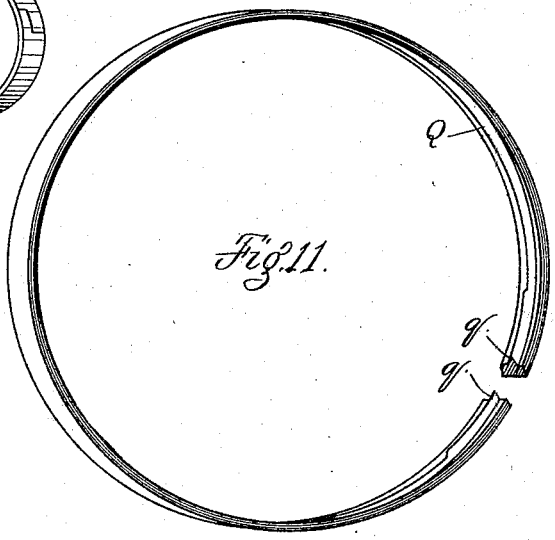


Fig. 11.



Witnesses.
George T. Smallwood Jr.
John Kobey Jr.

Inventor.
Geo. D. Harwood.
By. John J. Halsted.
his Atty.

UNITED STATES PATENT OFFICE.

GEO. D. HARWOOD, OF ANDREW COUNTY, MISSOURI, ASSIGNOR OF THREE-FOURTHS HIS RIGHT TO SAMUEL L. WILMER, OF JESSUP, IOWA, DAVID C. STOTTS AND JAMES H. BAKER, OF SAVANNAH, AND GEORGE H. ZIPH AND WILLIAM S. LEACH, OF ST. JOSEPH, MISSOURI.

IMPROVEMENT IN ROTARY ENGINES.

Specification forming part of Letters Patent No. **168,837**, dated October 19, 1875; application filed March 8, 1875.

To all whom it may concern:

Be it known that I, GEORGE D. HARWOOD, in the county of Andrew and State of Missouri, and formerly of Jessup, Buchanan county, Iowa, have invented a new and useful, safe, and economical application of steam-power; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings making a part of the specification, in which—

Figure 1, Sheet 1, is a perspective view of an engine embodying my invention, and Figs. 2 and 3, Sheet 2, details; Figs. 4, Sheet 3, sectional elevations, showing the valve-abutment and piston-head in two different positions; Fig. 5, Sheet 4, a cross-section of the wheel, wheel-case, and adjacent parts; and Figs. 6 to 11, details.

Referring to Fig. 1, A is a bed-plate or frame adapted to support the engine, and to permit the revolution of the wheel D, whose axis rests in appropriate journal-boxes thereon. B is a stationary wheel-case extending around the wheel, its inner periphery being (as shown in Fig. 5) formed or bored out to a half-circle in its cross-section, and thus adapted in connection with the wheel D, which is similarly shaped at its outer face or periphery, to form a continuous annular tube, having a circular cross-section. C C are side plates, which hold a separating-spring, hereinafter described, whose function is to divide the wheel-case from the wheel to aid in insuring the true position of the wheel in its revolutions, and to hold the packing-rings against the packing to secure a perfectly steam-tight joint. D is the wheel, formed or bored out, as above mentioned, and as shown in Fig. 5, so as in connection with the inner face of springs Q Q, hereinafter described, to form the one-half of the annular hollow cylinder, of which the stationary part B, as before named, forms the other half. E indicates a steam-supply pipe designed for supplying steam simultaneously to two opposite points on the wheel, one of these points being at or about the periphery, in a vertical line above the axis of the wheel, and the other being in the same vertical line, but on the opposite or under side of the axis of the wheel. This construction prevents any increase of friction on the shaft due to the pressure of the steam when admitted, because this pressure above the shaft equals and neutralizes that below the shaft; thus materially lessening the amount of steam or power required to run the engine, as compared with engines where the steam is admitted at any other point or points. As a consequence, there is less consumption of fuel and corresponding economy. F represents the exhaust-pipe, connected with the stationary part B of the wheel, and at two opposite points, viz., above and below the axis, and at the rear of the two opposite steam-chests hereinafter named. G is an oil-cup for supplying both of the separating-springs. H is a serpentine cam-groove on the wheel D for actuating through proper devices the cut-off valves of the two steam-chests, these devices consisting of a lever, I, whose friction-roller runs in the cam-groove, a rock-shaft, J, and the cut-off rod K, with its slide-valve *k*. The steam-chests are shown at L; each has but one port, *l*. In Fig. 4, Sheet 3, M represents the abutment, circular in form, and arranged to swing upon a hinge, as shown also in Fig. 9, and normally kept to its position by a spring, *m*, and it is provided on its periphery with a self-adjusting packing-ring T. One of the two similar piston-heads is shown at N; it is provided with a stem, *n*, extending through the wheel D, and to which it is secured by means of a nut, as shown. This piston-head has also a self-adjusting packing-ring, T. When the wheel D is revolving (in the direction shown by the arrows) and the piston-head approaches the pipe F, the rod K cuts off the supply of steam, and the draft or suction of the wheel, combined with the action of a portion of the exhaust steam, causes the abutment M to swing up under the cut-off-valve seat, as shown in the bottom figure of Sheet 3. When

N has passed through and is beyond the abutment M, and K has opened a full port, the entrance of the steam aiding the action of the spring *m*, forces back the abutment M to its seat, and thus compels the entering steam to act against the head N, and drive the wheel D around, it being of course understood that, on the opposite side of the wheel, steam is being received at the same time and the same action taking place.

Referring to Sheet 4, P is a V-shaped groove formed in the peripheral edge or faces of the wheel D, and adapted severally to receive the V-shaped projection or projections *q* on a spring, Q, which forms a stationary separating-ring between the wheel D and the wheel-case B. This ring, shown enlarged in Fig. 11, fits in the groove P snugly enough to form a true guide for the wheel in its revolutions, and consistent with its allowing sufficient room to admit some steam to act as a counter-balance, holding all dead friction off of the wheel. R (shown enlarged in Fig. 3) is a solid square packing-ring, which presses the hemp, rubber, or other packing between the top of Q and the wheel-case B, and into the annular cavity or recess made in such wheel-case to receive this ring and packing. Set-bolts S may be used, passing through the side plates C, and coming in contact with the packing-rings, to serve the purpose of adjusting or compacting the packing. The side plates C, as above stated, when bolted to place, not only hold the separating rings Q to place, but also hold the packing-rings R tightly against the packing, thus making a perfect steam-joint. These plates, however, should not so bear against the sides of the wheel D as to impede its free revolution.

What I claim, and desire to secure by Letters Patent as improvements in rotary steam-engines, is as follows:

1. The combination of an annular stationary case, having its inner face concave in semicircular form, with a revolving wheel, having its periphery or outer face similarly concave, the two, when placed together with an interposed packing between these two faces, composing an annular hollow steam-cylinder, the inner or wheel half of which is adapted to revolve within the stationary part.

2. In combination with the described stationary wheel-case B and with the wheel D, the separating-rings Q, provided each with a rib or projection to fit the grooves P in the wheel, and the packing-ring R and its packing, as and for the purpose set forth.

GEORGE DAVID HARWOOD.

Witnesses:
A. W. MADDEN,
M. DEMPSEY.