C. T. Boardman,

Rotary Steam Engine.

No. 38,805. Patented June 9, 1863.

Fig. 3.

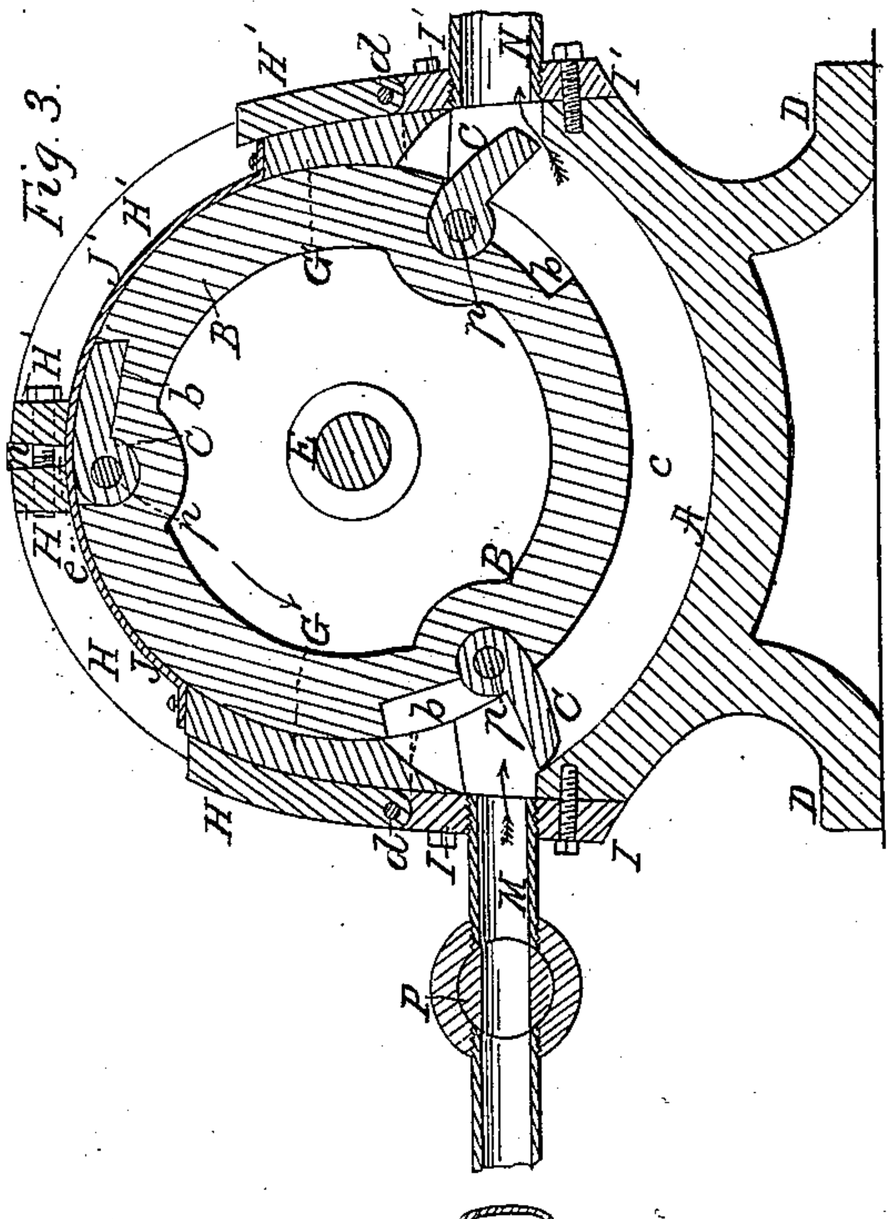


Fig. 4

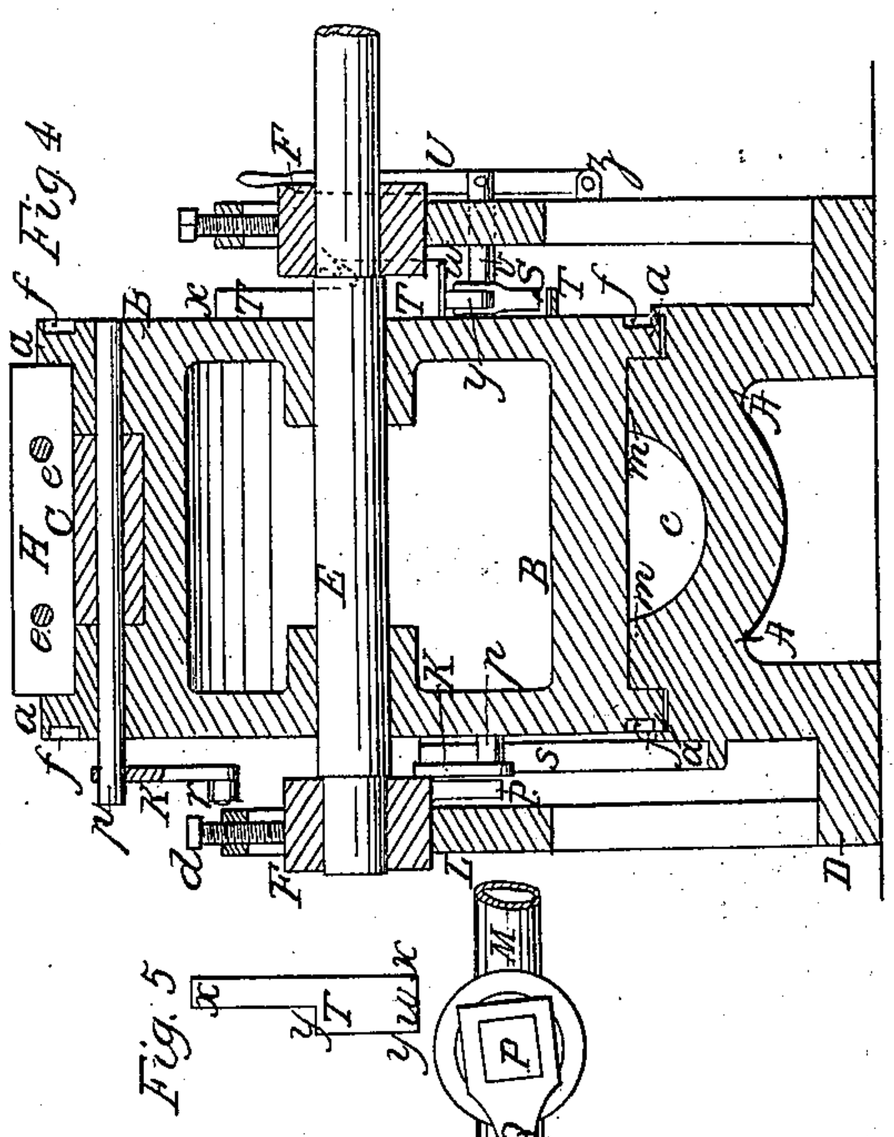


Fig. 1

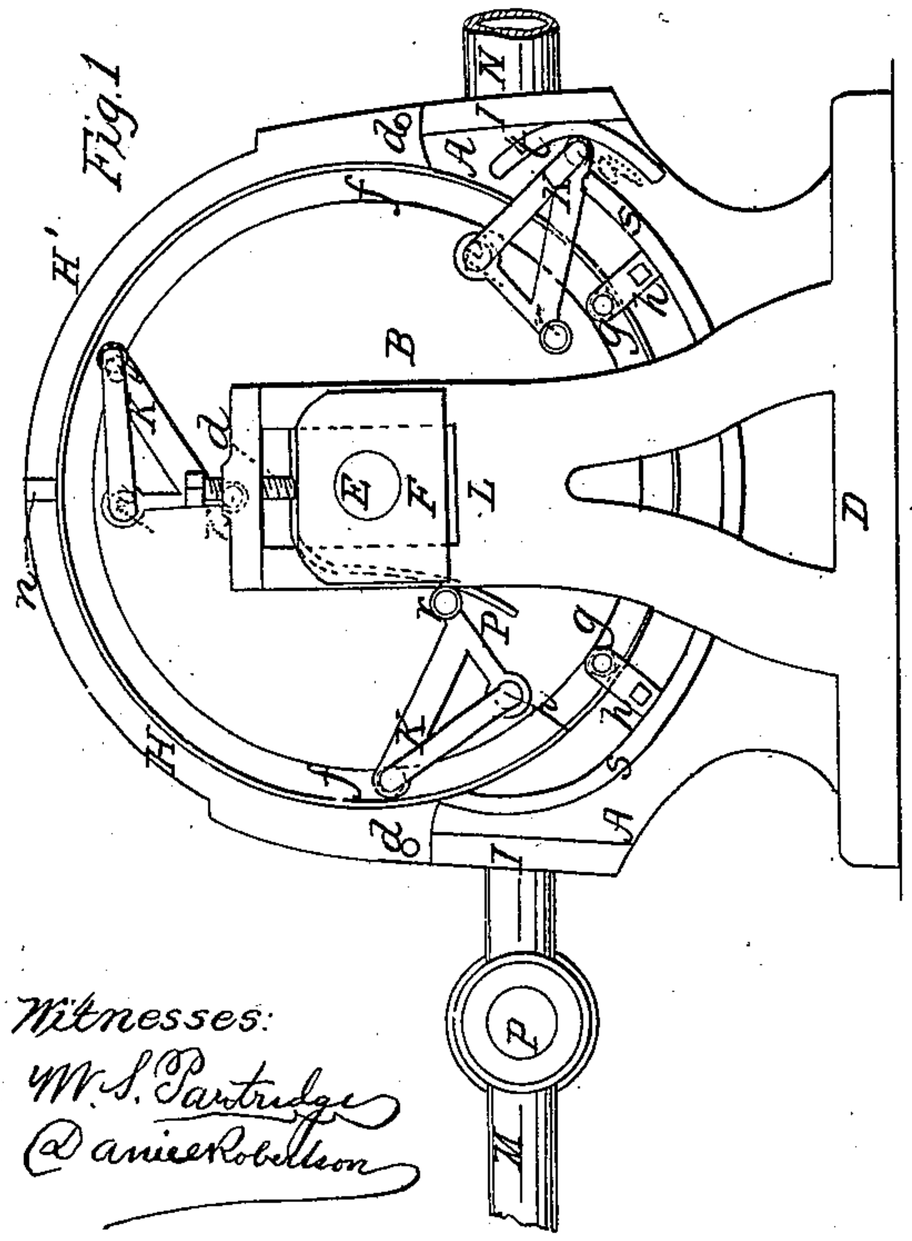
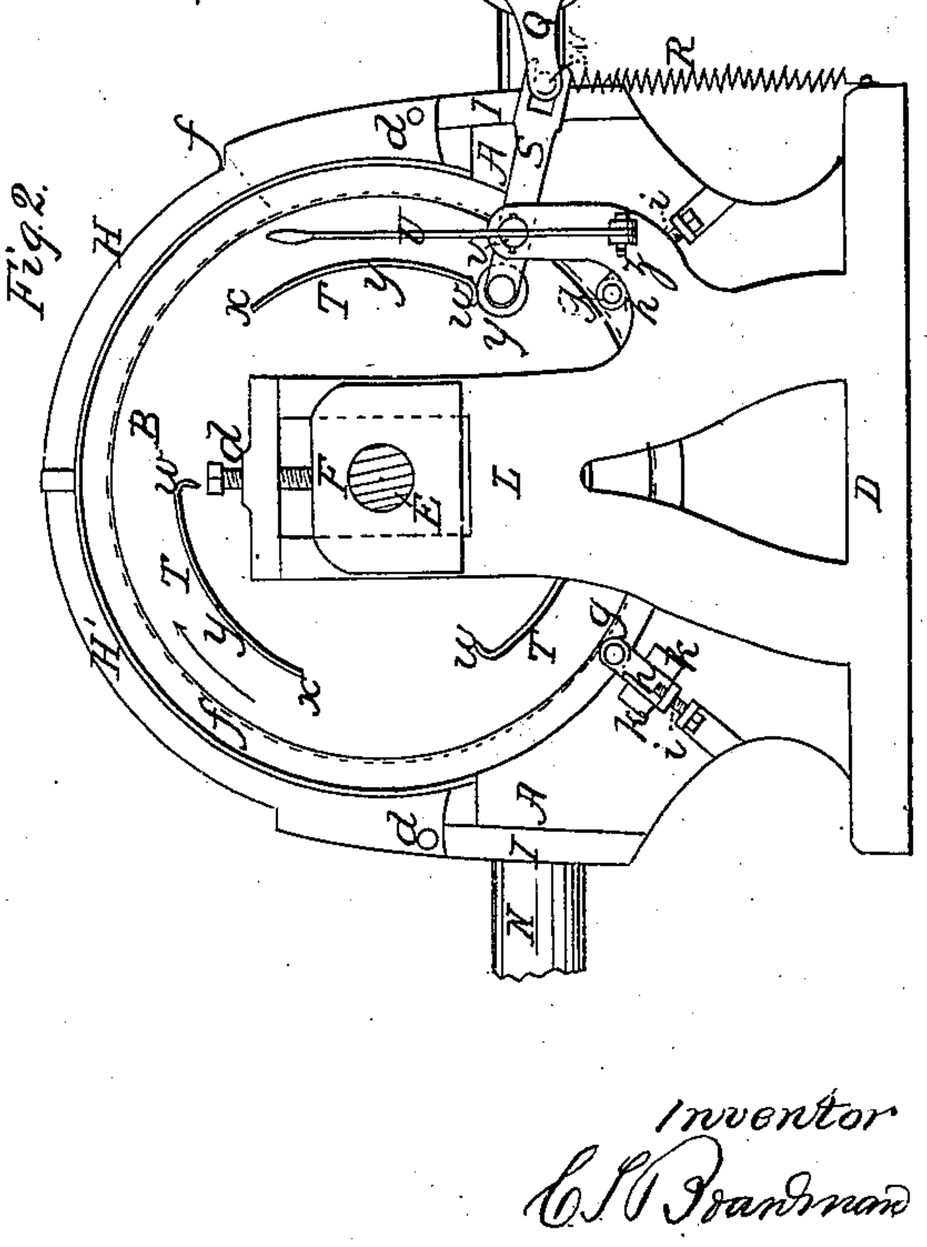


Fig. 2.



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UNITED STATES PATENT OFFICE.

C. T. BOARDMAN, OF BERGEN POINT, NEW JERSEY.

IMPROVED ROTARY ENGINE.

Specification forming part of Letters Patent No. **38,805**, dated June 9, 1863.

To all whom it may concern:

Be it known that I, C. T. BOARDMAN, of Bergen Point, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figures 1 and 2 are opposite side elevations of an engine with my improvements. Fig. 3 is a vertical section of the same at right angles to the shaft. Fig. 4 is an axial vertical section of the same. Fig. 5 is a face view of one of the cut-off cams.

Similar letters of reference indicate corresponding parts in the several figures.

This invention consists in a novel construction of the stationary steam-cylinder and its abutments and mode of combining them with the rotating cylinder or piston wheel, to which the pistons are attached, whereby I am enabled to dispense to a great extent, if not wholly, with the use of packing and avoid the use of working joints composed of surfaces perpendicular to the axis of rotation, which are so difficult to keep steam-tight in rotary engines.

It also consists in certain means of operating the pistons to bring them to positions to be operated upon by the steam, and into positions to pass the abutments of the stationary cylinder as required, and in certain means of cutting off the steam from the pistons at various points in their revolutions to provide for working the steam more or iess expansively.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A is the portion of the engine commonly termed the "cylinder." This in my engine is not, geometrically considered, a cylinder, but merely a segment of one, receiving within it a sufficient portion of the circumference of the rotating cylinder or piston-wheel B to embrace two of the pistons C C. This cylinder A is formed in the same piece with or secured to a base, D, which keeps it stationary on any suitable foundation on which it may be placed, and it has formed in its interior the steam-channel *c*, which is of semicircular or nearly semicircular form in its transverse section. The rotating cylinder B, which may be called the "piston-wheel" to distinguish it from A, may be either solid or hollow, and is made with an external flange, *a*, at each side. The portion between the said flanges forms a complete cylinder, with the exception that recesses *b b* are provided in it for the reception of the pistons, and the said portion fits to the cylindrical faces *m m*, provided in the cylinder A on opposite sides of the steam-channel *c*. The flanges *a a* lap over the sides of the cylinder, or enter rabbets formed therein, and serve to prevent any movement of the wheel in the line of its axis. The said wheel is firmly keyed to the concentric shaft E, which is the main shaft of the engine, and which has its journals fitted to boxes F F, which are arranged in housings in vertical standards L L and held down by set-screws *d d*. These set-screws assist in holding down the wheel in the cylinder against the pressure of steam in the channel *c*, which tends to lift up the said wheel. In the sides of the said wheel B, or in the outer faces of its flanges *a a*, there are turned annular grooves *f f* for the reception of anti-friction rolls *g g*, the journals of which are fitted to bearings in plates *h h*, which are secured to the cylinder A. These anti-friction rollers serve to assist in holding down the piston-wheel against the upward pressure of steam, and in order to provide for their adjustment, to compensate for the wear of any of the parts, or for any other purpose, the plates *h h* are arranged to work in guides *k k* radial to the wheel and made adjustable therein by means of adjusting-screws *i i*, as shown in Fig. 2.

G G′ are the cylinder-abutments, fitted into the cylinder A at each end of the steam-channel, and serving to close the ends of the said channel, and fitting between the flanges *a a* and to the periphery of the piston-wheel. They are held in place by means of two arc-formed clamps, H H′, portions of which fit to the cylindrical periphery of the piston-wheel, between the flanges *a a*, and portions of them to the abutments. The lower ends of these clamps are connected by hinge-joints *d d* with plates I I′, which are bolted to the cylinder A, and their upper parts are connected together by screws *e e*, which enable them to be drawn tightly upon the piston-wheel and to draw the abutments closely thereto. Small

blocks *n n* are fitted between the upper ends of the clamps to prevent them from clamping the piston-wheel and the abutments so tightly as to produce undue friction, and these blocks may be removed and filed away as often as necessary to allow the clamps to be brought closer together for the purpose of compensating for wear. The clamps H H′ also assist in holding down the piston-wheel against the upward pressure of steam.

J J′ are guard-plates, made of sheet metal, of a form to fit the periphery of the piston-wheel, attached to the abutments, and held to the piston-wheel by the clamps H H′, for the purpose of confining the pistons C C in the recesses *b b* of the wheels while they are out of the cylinder A. The abutments are made to taper in an upward direction, that they may be kept tight by the pressure of the steam notwithstanding their own wear and that of the cylinder. The pistons C C are brought out to their operative positions and back again into the piston-wheel, as the said wheel rotates in the direction of the arrow shown upon it by means of a swinging movement, and for this purpose they are securely attached to shafts *p p*, which are fitted to suitable bearings in the piston-wheel, and these shafts pass through stuffing-boxes in one side of the wheel, and protrude through the exterior thereof, and the protruding portions are furnished with bell-cranks K K, each of which is furnished with two projecting studs, *q r*, the former projecting in an inward direction toward the piston-wheel and the latter in an outward direction from the said wheel. These bell-cranks are for the purpose of throwing out the pistons as they severally pass the abutment G, which is over the induction-pipe M, and of throwing them back into the recesses *b* as they severally approach the exhaust-pipe N, which is situated just below the abutment G′. The throwing out of the pistons is effected by the studs *r* of the bell-cranks coming in contact with and passing along the surface of the inclined bar P, which is attached securely to one of the standards L. This bar is made of steel and slightly elastic to prevent any hammering action of the bell-cranks. When the pistons have been thrown out, they are held out by the studs *q* of their bell-cranks coming in contact with and passing along the outer surface of an arc-formed projection, *s*, on the side of the cylinder A, and they are thrown in again at the proper time by the studs *r* of their respective bell cranks coming into contact with and passing along the inner face of a short curved projection, *t*, on the side of the cylinder A.

Fig. 1 shows the stud *q* of one of the bell-cranks as just having escaped from the projection *s*, and about to come in contact with the projection *t*, to throw in its respective piston, and also shows the stud *r* of the next bell-crank as coming into contact with the bar P, to throw out its respective piston.

Fig. 3 shows the piston-wheel as having moved a little farther, and one piston as having been thrown out and the other commencing to be thrown in.

The studs *q* and *r* may be fitted with anti-friction rollers.

P is a cut-off consisting of a valve of any suitable kind, arranged in the induction-pipe M near the cylinder. This valve has attached to its spindle an arm, Q, to which a spring, R, is applied in such a manner as to close it, and the said arm is also connected by a slot-and-pin connection, *u*, with a lever, S, which works up and down in planes perpendicular to the axis of the shaft E on a fulcrum, *v*, which is arranged on the opposite side of the engine to that on which the bell-cranks for operating the pistons are arranged.

T T are cams corresponding in number with the pistons, attached to the piston-wheel at equal distances apart, to operate upon the lever S, for the purpose of opening the cut-off valve P every time a piston passes the abutment G, and keeping it open to admit steam to act upon the piston until the latter arrives at a desirable point in its passage through the cylinder A, and then to permit the spring R to close the said valve and cut off the steam, to allow the remainder of the movement of the piston through the cylinder to be completed by the expansive force of the steam. The cut-off valve is opened quickly by the rounded ends *w* of the cams, and, owing to the remainders of the surfaces of the cams being concentric with the axis of the piston-wheel, is kept wide open until the cam passes the lever and allows the valve to close suddenly. The cams are made double—that is to say, the portions *x x* of the cams next the piston-wheel are made longer than the outer portions, *y y*, so that by shifting the lever S farther from or nearer to the cylinder to be acted upon by the shorter portions, *y y*, or longer portions, *x*, of the cams, the steam may be cut off earlier or later to work more or less expansively.

Instead of making the cams only double, as represented, to cut off at two different points, they may be made triple or quadruple to cut off at three or four different points.

To provide for shifting the lever S for cutting off at different points, the fulcrum *v* is fitted to slide in a bearing in the standard L, and connected with a hand-lever, U, arranged to work toward and from the piston-wheel on a fixed fulcrum, *z*. This lever U allows the lever *s* to be shifted to vary the cut-off while the engine is in operation. The lever S is fitted with a friction-roller, 7, for the cams to work against.

It will be observed that in this engine cylinder-heads are dispensed with, and the trouble of keeping steam-tight flat revolving surfaces is obviated. The only surfaces requiring to be kept tight between the cylinder and the piston-wheel are the peripherical surfaces of the piston-wheel, the surfaces *m m* of the cylinder on opposite sides of the steam channel *c*,

and the faces of the abutments, and in all of these packing may be dispensed with, and the whole of the working-surfaces are reduced to a very small number. The only packing that is required is a stuffing-box at one end of each of the shafts *p p*.

This engine may, by taking away the cut-off and applying power to the shaft to turn the piston-wheel in the reverse direction to that indicated by the arrows in the drawings, be converted into a pump.

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

1. The cylinder A, constructed to receive only the lower portion of the piston-wheel, and having its abutments G G′ combined with it and the piston-wheel by means of hinged clamps H H, which also serve to confine the said wheel to its place in the cylinder, substantially as herein specified.

2. The adjustable plates *h h* and anti-friction rollers *g g*, applied in combination with the cylinder and with the groove *f* in the piston-wheel, substantially as and for the purpose herein described.

3. The combination, with the swinging pistons C C, of the bell-cranks K K, furnished with studs *q r*, the bar P, and the projections *s t* on the cylinder, the whole arranged substantially as herein described to operate the pistons.

4. Making the abutments G G′ of taper form, and so fitting them between the cylinder and the piston-wheel that they may be kept tight by the pressure of steam, substantially as herein described.

5. The combination of the variable cut-off cams T T with the cut-off valve by means of a system of levers, S and U, combined to operate substantially as and for the purpose herein set forth.

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