No. 646,393. Patented Mar. 27, 1900.

R. SMITH.

ROTARY ENGINE.

(Application filed June 6, 1898. Renewed Sept. 11, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 3.

Enlarged.

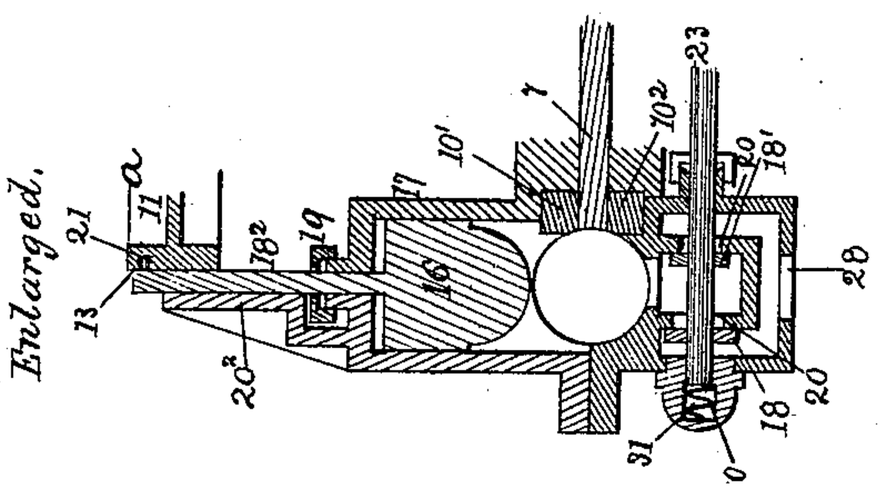


Fig. 2.

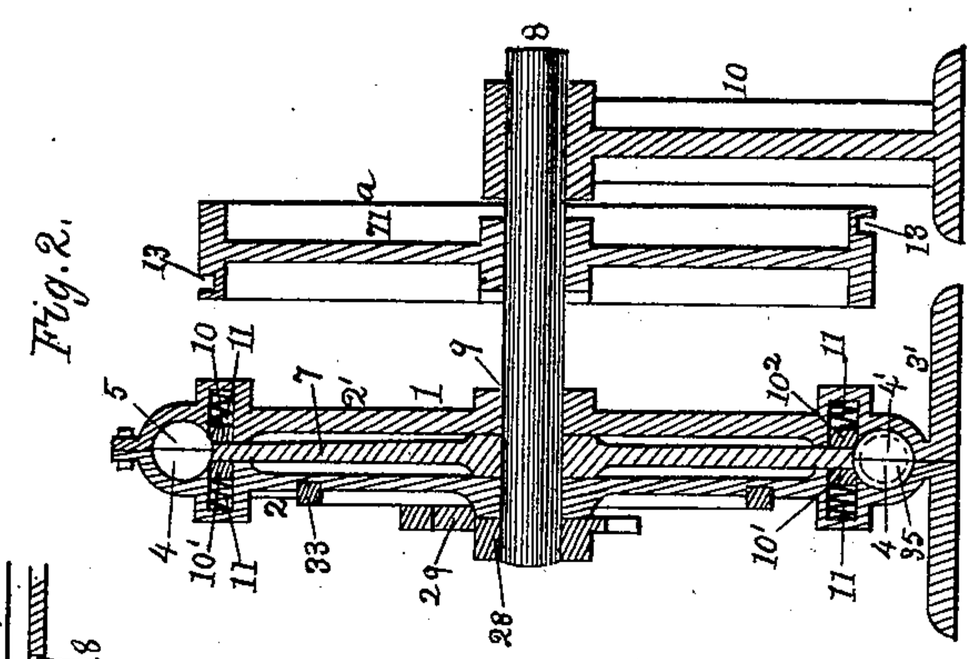


Fig. 4.

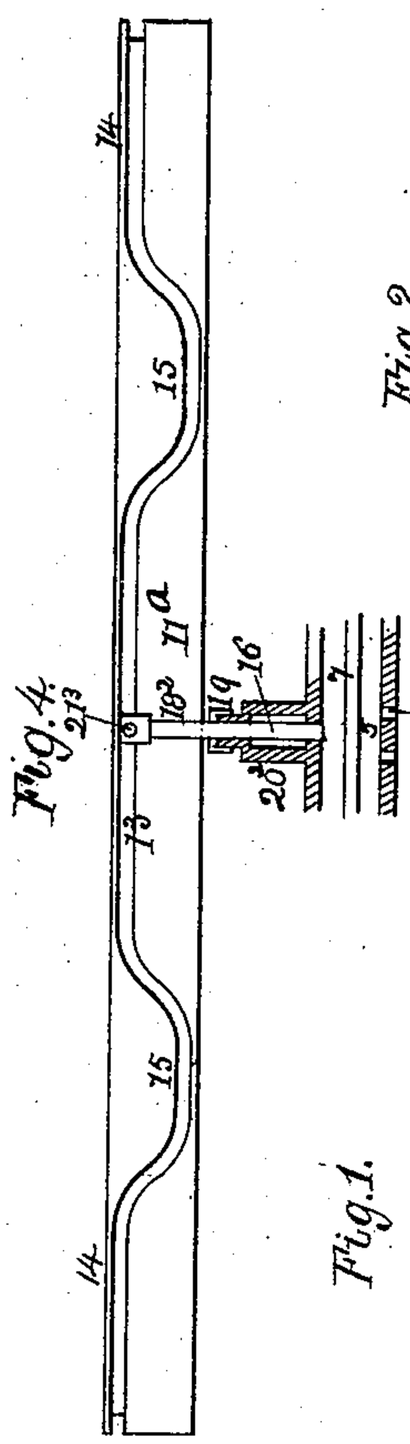
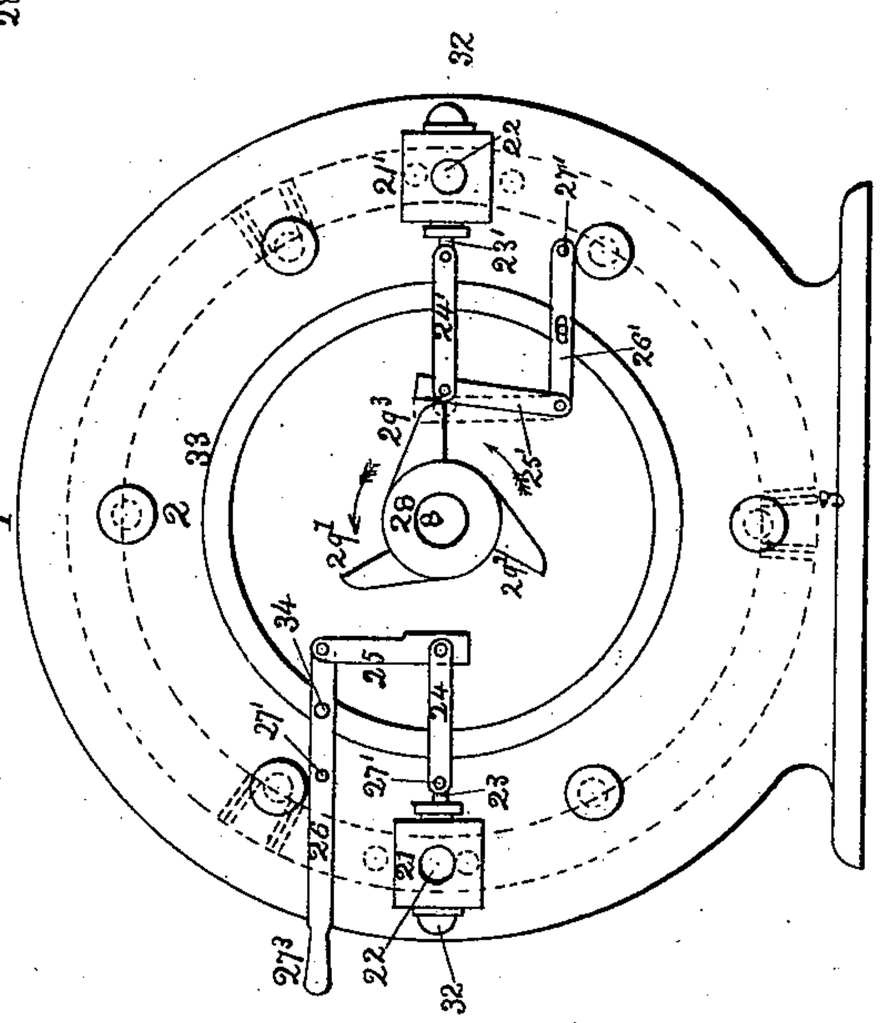


Fig. 1.



Witnesses

H. A. Curtis

Nellie Conly

Inventor.

Richard Smith.

by F. Curtis. Attorney

No. 646,393. Patented Mar. 27, 1900.

R. SMITH.

ROTARY ENGINE.

(Application filed June 6, 1898. Renewed Sept. 11, 1899.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 8.

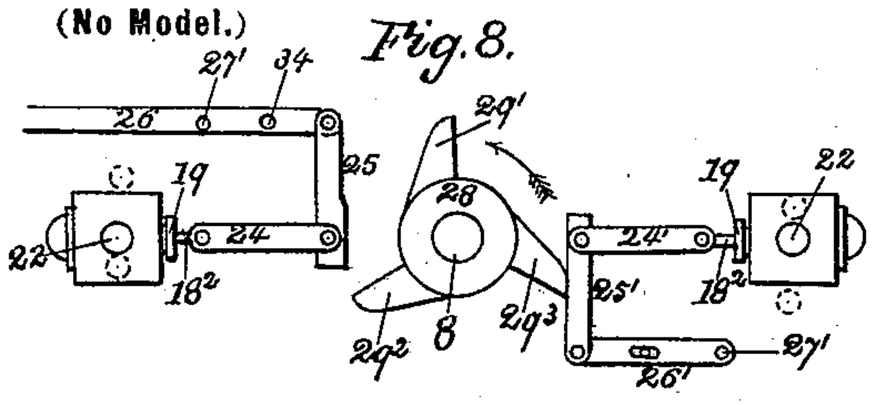


Fig. 6.

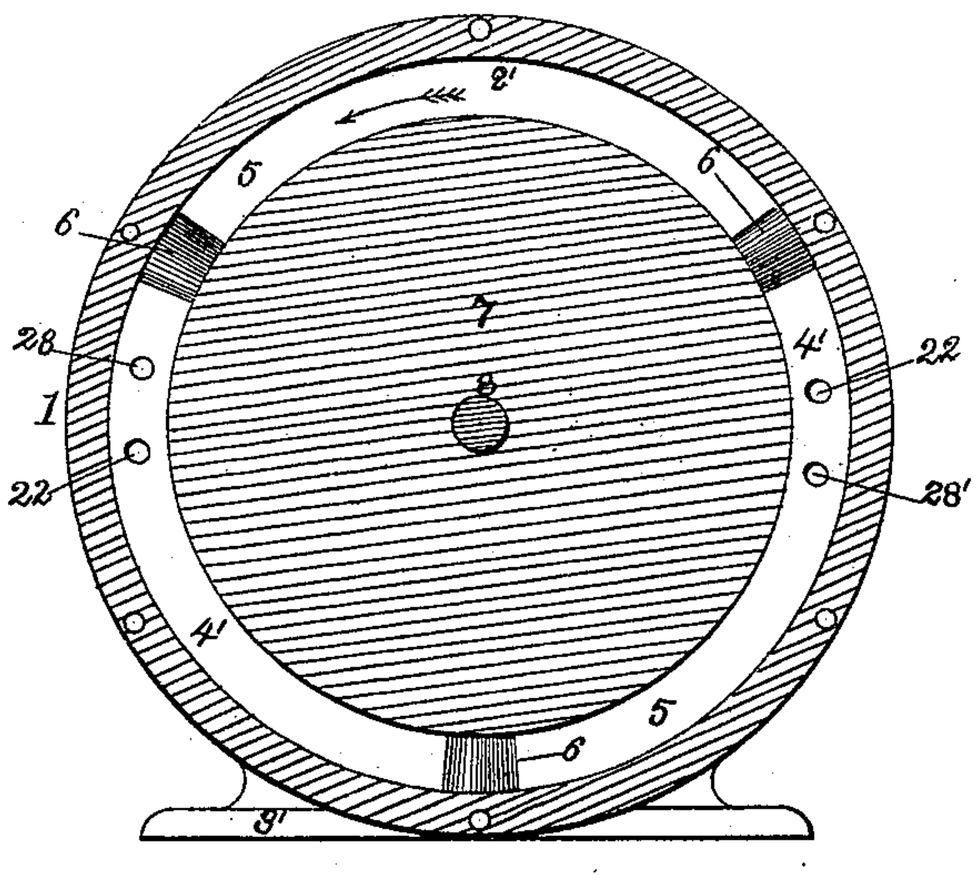
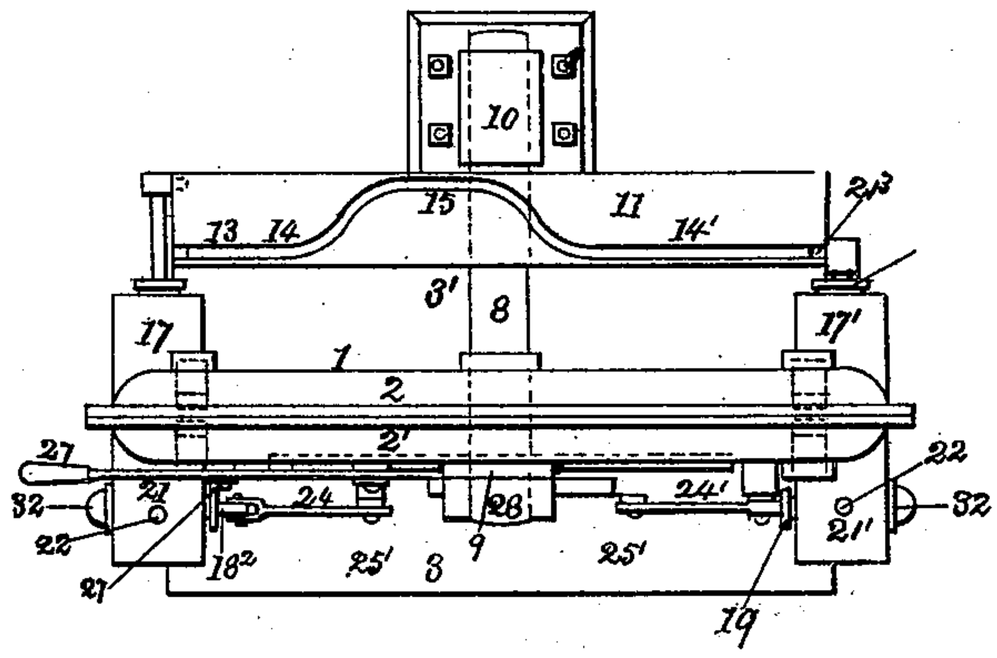


Fig. 5.



Witnesses.
H. A. Curtis.
M. J. Curtis

Inventor.
Richard Smith.
By F. Curtis. Attorney.

No. 646,393. Patented Mar. 27, 1900.

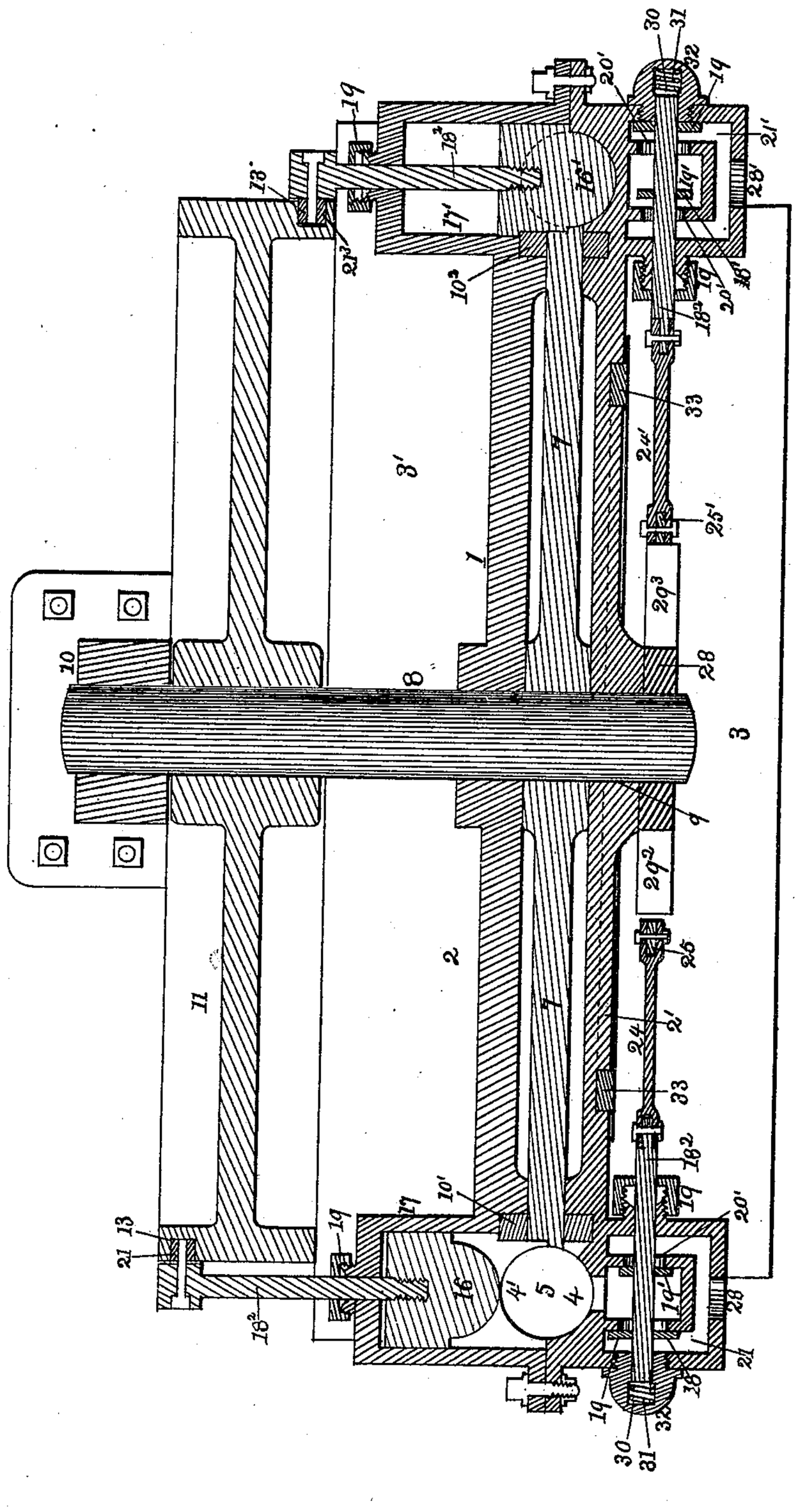
R. SMITH.

ROTARY ENGINE.

(Application filed June 6, 1898. Renewed Sept. 11, 1899.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 7.



Witnesses.
H. R. Curtis
M. J. Curtis

Inventor
Richard Smith.
By Frederick Curtis. Attorney.

UNITED STATES PATENT OFFICE.

RICHARD SMITH, OF SHERBROOKE, CANADA, ASSIGNOR OF ONE-HALF TO WILLIAM FARWELL, OF SAME PLACE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 646,393, dated March 27, 1900.

Application filed June 6, 1898. Renewed September 11, 1899. Serial No. 730,183. (No model.)

To all whom it may concern:

Be it known that I, RICHARD SMITH, of Sherbrooke, in the county of Sherbrooke and Dominion of Canada, have invented a new and useful Rotary Steam-Engine, of which the following is a specification.

In this engine I obtain, in common with others of its class, the advantages due to a continuous rotary motion in one direction, which obviates the waste of steam-power and other loss due to the sudden reversal of motion of the piston of a reciprocating engine, and I have endeavored in my present engine to reduce to the lowest point possible the loss by friction, especially between the piston and cylinder, to which rotary engines have heretofore been subject, and at the same time to secure the greatest amount of power practicable from a given quantity of fuel.

My invention consists chiefly in certain improvements in the packing devices, the steam-valve-operating mechanism, and the means for regulating the expansion of the steam, as well as in the general construction and details of my machine, all substantially as hereinafter more particularly set forth and claimed.

The drawings accompanying this specification and illustrating my invention represent, in Figure 1, an elevation, and in Fig. 2 a vertical section, of a rotary steam-engine containing my improved construction. Fig. 3 is a horizontal section of one of the steam chests and valves and the sliding or shifting gate and its operative mechanism enlarged. Fig. 4 is a plan, developed upon a plane, of the cam-groove for operating the shifting cylinder-head or gate with such gate shown in section. Fig. 5 is a plan, Fig. 6 a vertical cross-section, and Fig. 7 a horizontal section, of my engine, the latter figure being on an enlarged scale. Fig. 8 is a diagram of the "cut-off" mechanism.

In the drawings, 1 represents the general body or case of the engine, which consists of twin vertical circular casings 2 2′, terminating at bottom in semiflanges or bases 3 3′, which together constitute the bed-plate, each casing having upon its interior face and near its circumference a semicylindrical annular channel 4 or 4′, which when the two casings are bolted together face to face form the common piston chamber or cylinder 5 of the engine.

The pistons which travel the cylinder 5 are shown, as in the present instance, three in number, at 6 6 6, such pistons being cylindrical in cross-section and of a diameter to closely fill the cylinder, and these pistons are to be "packed" with some one of the various packing devices now employed in reciprocating engines for preventing escape of steam between the piston and cylinder. The pistons 6 are equidistant and are secured to the periphery of a circular plate or carrier 7, secured axially to a horizontal shaft 8, mounted at its front end in a bearing 9 in the body of the engine and extending rearward through bearings in a suitable standard 10, erected upon the general bed-plate of the engine or floor of the engine-room in rear of the engine proper.

As the periphery of the piston-carrier 7 extends to the piston chamber or cylinder, it becomes necessary to pack the outer part of such carrier to prevent escape of steam between the piston-chamber and the inclosure which receives the piston-carrier, and to this end I interpose a suitable packing, which in the present instance is shown as composed of two circular flat rings 10′ 10^2, contained within oppositely-disposed annular channels in the said casings, these packing-rings being crowded up to the contiguous face of the piston-carrier by springs 11 11, &c., which are contained in pockets formed in bosses in the opposite semicasings and exert their stress between the bottom of each pocket and the ring.

Between the body of the engine and the standard 10 and secured axially to and rotating with the shaft 8 and in unison with the piston-carrier 7 is a circular head or drum 11^a, in the periphery of which is sunk an endless cam-groove 13. This groove 13 is to operate the shifting gate or cylinder-head and is formed in two alternating divisions or sections 14 14 and 15 15, the former being disposed upon one side of the periphery of the drum and being of considerably-greater length than the latter, which are disposed upon the opposite side of such periphery, the distance between the two sections laterally of the periphery determining the extent of throw of

the gate. When the antifriction-roller of the rod of the shifting gate is in a long division of the cam-groove, the gate is closed and steam is entering the cylinder to drive a piston. When such roller stands in a short division of the groove, the gate is open to permit of passage past it of the next approaching piston, and the cam-groove is so "timed" with respect to the mechanism that operates the steam-inlet valve that simultaneously with the closing of the gate the valve opens to admit steam to the cylinder. If the steam is to work expansively in the cylinder until its pressure therein is reduced to that of the atmosphere, or practically so, or if it is to be carried under a full head until the piston completes its stroke, in either case as it is about to exhaust the gate opens.

The gate is not intended to govern the exhaust; but should it, as might sometimes occur, open before the exhaust proper opens a portion of the exhaust-steam would escape rearward past the gate and exhaust through the port next in rear.

The shifting gates or cylinder-heads are shown in the drawings at 16 or 16′ as disposed upon diametrically-opposite sides of the engine-casing and in alinement with the steam chests and valves, as shown in Fig. 7 of the drawings, and each is in the form of a flat plate of a size and form in cross-section to tightly fill the cylinder transversely of the latter. Each gate when shut constitutes the cylinder-head to receive the impact of the steam. When open, the cylinder is unobstructed and permits of passage of a piston past the gate. Each gate 16 or 16′ is contained within a closed box 17 or 17′, secured to the rear of the casing or body of the engine and directly opposite the steam-chests 21 21′, each box opening directly into the cylinder of the engine, as shown in Fig. 3 of the drawings. Each gate is formed or provided with a stem or rod 18^3, which extends outwardly through an external stuffing-box 19 and a suitable bearing-bracket, such rod carrying at its outer extremity an antifriction roller or stud 21^3, which takes into the cam-groove 13, before explained.

The steam-valves of the engine are shown at 18 18′ as of any well-known modern construction, being in the present instance composed of two circular disks secured to a common stem and operating with oppositely-disposed seats 20, opening into the interior of each steam-chest 21 or 21′, the steam-supply opening of which is shown at 22.

To operate the valve, I have in the present instance adopted the following mechanism: To the inner end of each piston-rod 23 or 23′ is pivoted the outer end of a horizontal link 24 or 24′, the opposite or outer end of such link being pivoted to one end of a vertical arm 25 or 25′, one of such arms—viz., 25—being disposed above the axis of the engine and the opposite arm 25′ below such axis. The opposite end of each arm 25 or 25′ is pivoted to the inner end of a horizontal bar 26 or 26′, the outer end of each bar being pivoted to the body of the engine, as shown at 27′, the upper lever 26 terminating at its outer and free end in a handle 27^3, for purposes hereinafter explained. To the outer end of the shaft 8 is fixed a hub 28, upon the periphery of which are formed three wiper-cams of equal sweep $29'$ 29^2 29^3, these cams being so disposed as to wipe in succession against the inner end of each link 24 or 24′, and in so doing open each valve alternately to admit steam to the steam-chests and the cylinder. As each cam successively passes by after opening the valve such valve is closed by the action of a spring 30, such spring in the present instance being a spiral one located in a cell 31, formed in a cap or cover 32, which covers the outer end of the valve-stem, such spring exerting its stress between the cap and the end of the stem.

The arrangement of the wiper-cams and of the twin-valve-operating mechanism is such that when one cam is in a position to open the valve to admit steam to the cylinder, as shown by the cam 29^3 in Fig. 1 of the accompanying drawings, its fellow cams are out of contact with the opposite valve mechanism and this latter valve is closed. As the cam 29^3 leaves the valve 18′ and the latter closes by the action of its spring the cam 29′ in advance of it opens the opposite valve 18 to admit steam to the cylinder, the cams thereafter acting to successively open and close the valves, as will be readily apparent to good mechanics.

To govern the extent of expansion of the steam in the cylinder by cutting off the supply of such steam at any desired point in the traverse of a piston, I employ in the present instance a flat annular circular plate or ring 33, which is applied to the front of the engine-casing in a manner to permit of part rotation in its bearings, and to the front face of this ring I pivot the lever or bar 26 at a point approximately near its inner end, as shown at 34. It will be seen that by turning the ring 33 slightly (by means of the lever 26) in one or the other direction the upright arms 25 25′ are rocked in corresponding manner and the extent of their throw and the movements of the valves increased or diminished, as the case may be.

The exhaust-ports of the engine, which are always open to the atmosphere, are two in number, corresponding to the number of valves, and are shown at 28 28′ as situated at diametrically-opposite sides of the engine-casing and making exit from the cylinder at points slightly in rear of the steam-chests.

The operation of the above-described engine is as follows: Supposing as a starting-point the gate 16 to be closed and a piston 6 slightly in front of it, the valve 18′ in steam-chest 21′ being about to open by the action of the wiper-cam 29^3, which travels in the direction of the arrow 40, (see Fig. 7 of the drawings,) and the opposite valve 18 closed

by its spring, and the cams 29′ and 29² being idle, the antifriction-roller of the rod of the gate 16 resting in the beginning of one of the long sections of the cam-groove 13, steam flowing through the port of valve 18′ passes between the gate 16 next in front of it and the piston-carrier 7 begins its rotation in the direction of the arrows in Figs. 1 and 6 of the drawings, and the various pistons begin their traverse of the cylinder, and this continues until the piston first named reaches the point at which steam is to be cut off from the cylinder, when the wiper-cam 29³ passes by the valve 18′ and allows the latter to be closed by the action of its spring, the wiper-cam 29′ in the meantime advancing toward the arm 25 of the opposite valve mechanism in the direction of the arrows before alluded to. The active piston continues its journey until its stroke of one-half of the cylinder is completed, and it passes by the exhaust-port next in front of it for the escape of the exhaust-steam, the antifriction-roller 21³ of the gate 16 during this movement of the piston remaining in the said long section of the cam-groove until the said exhaust-port opens, at which time the roller of gate 16 enters the short section next ensuing of the cam-groove, and thereby opens the said gate and leaves the cylinder unobstructed to permit of passage of the next advancing piston, which at this time is immediately behind the gate. As this second piston passes beneath the gate the roller of such gate enters the next or long division of the cam-groove and closes the gate behind the piston. Simultaneously with this closing of the gate and of the cylinder the wiper-cam 29′ has reached the arm 25 of the mechanism for operating the opposite valve 18 and the latter opens and admits steam between the gate and piston. This second piston now continues its journey until the steam has been cut off and the opposite exhaust-port 42 has been opened and the opposite gate opened to permit of passage of a piston and closed behind it, at which time the wiper-cam 29² is about in contact with the arm 25′ of the mechanism for opening the opposite valve 18′ first named, and the antifriction-roller of the gate 16′ is in the beginning of the next ensuing long division of the cam-groove, (having left the short division as the gate closes,) and we are brought to the starting-point.

I claim—

1. The mechanism for operating each valve, consisting of a link and a valve-stem, to one end of which the said link is connected, in combination with a vertical arm connected to the other end of the said link, a lever to which this arm is pivoted, the trip-cams carried by the engine-shaft and acting to open the said valves, the springs which tend to close the latter, and a supporting device on which the said lever is pivoted, substantially as set forth.

2. The mechanism for operating each valve, consisting of a link and a valve-stem, to one end of which the said link is connected, in combination with a vertical arm connected to the other end of the said link, a lever to which this arm is pivoted, the trip-cams carried by the engine-shaft and acting to open the said valves, the springs which tend to close the latter and a ring 33 on which the levers for operating the valves are pivoted and the casing on which the said ring is mounted in such manner as to permit its rotary adjustment, substantially as set forth.

3. In a rotary engine, the combination with a revolving piston-carrier and an engine-case in which it works, of gates 16 and means for moving them automatically into and out of the cylinder to form partitions therein or allow the passage of a piston, devices for supplying steam between such gates and the pistons to continuously drive the carrier, valves for cutting off the supply of steam at any point to regulate its expansion, levers for opening the said valves, springs tending to close the said valves, a series of rotary cams arranged to operate the said levers and a series of links connecting the said levers respectively to the stems of the said valves, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

RICHARD SMITH.

Witnesses:

F. CURTIS,

O. H. THORNTON.