No. 702,624. Patented June 17, 1902.

W. L. CASADY.

ROTARY ENGINE.

(Application filed Dec. 9, 1899.)

(No Model.)

3 Sheets—Sheet 1.

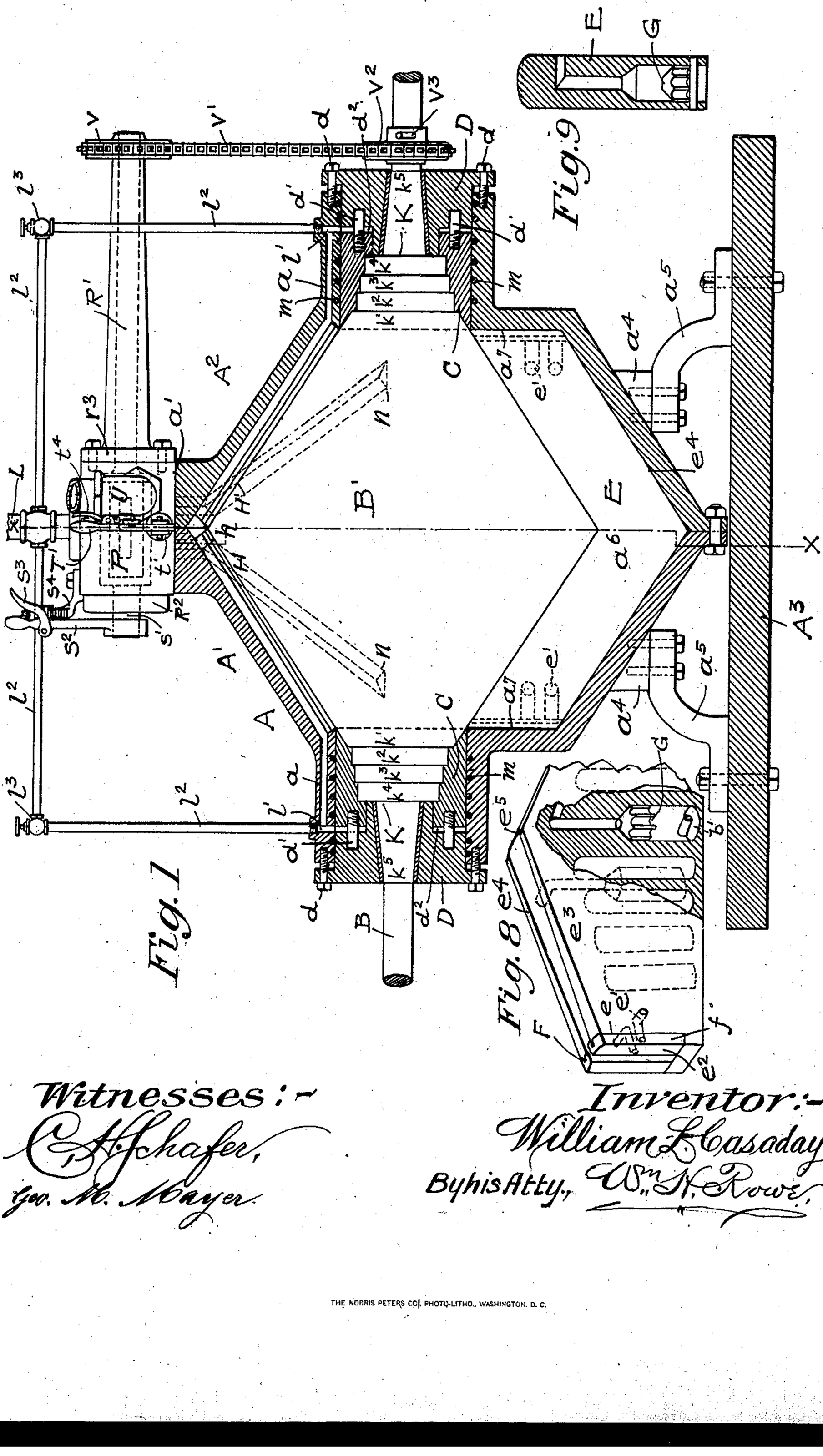

Fig. 1

Fig. 9

Fig. 8

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3 Sheets—Sheet 2.

Fig. 2

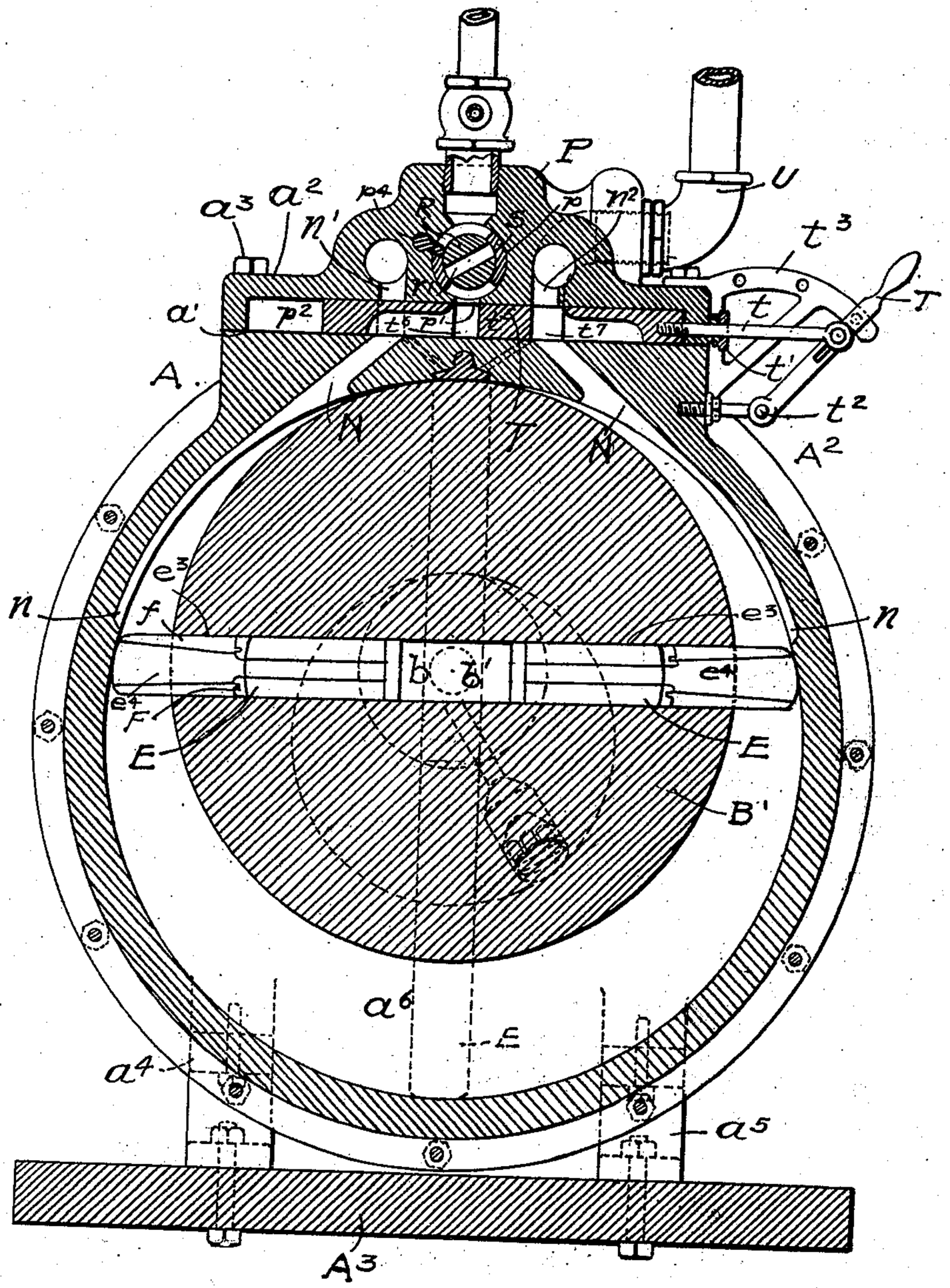

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Fig. 3

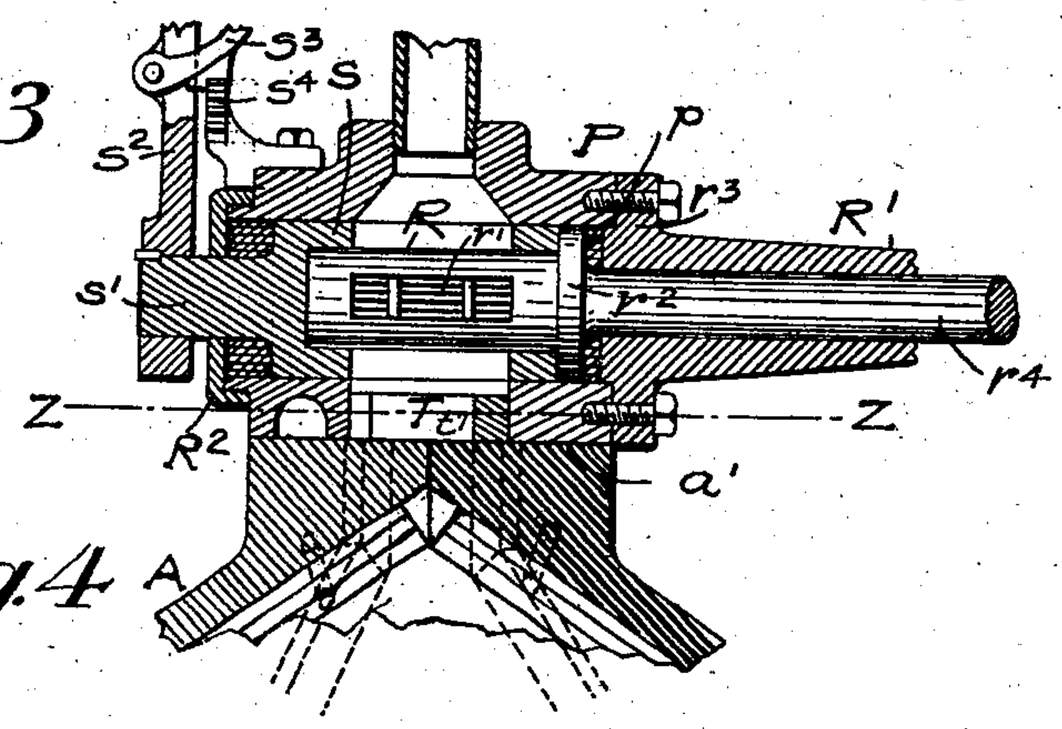


Fig. 4

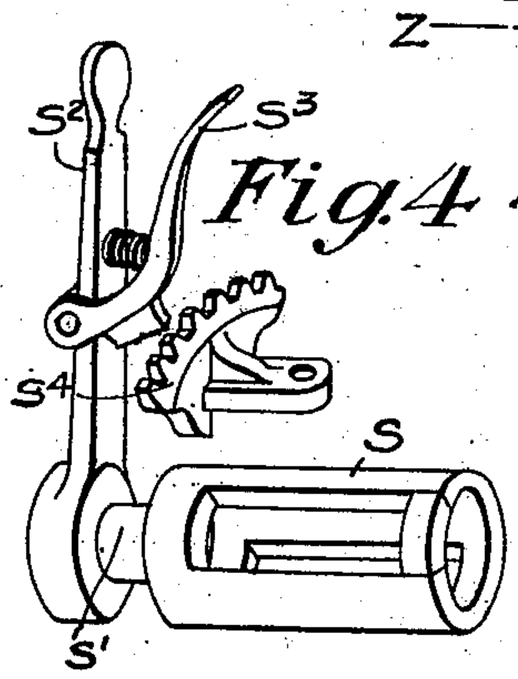


Fig. 10

Fig. 5

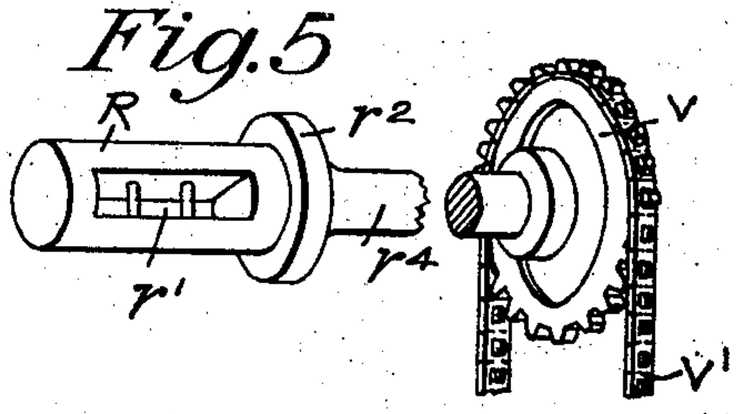


Fig. 6

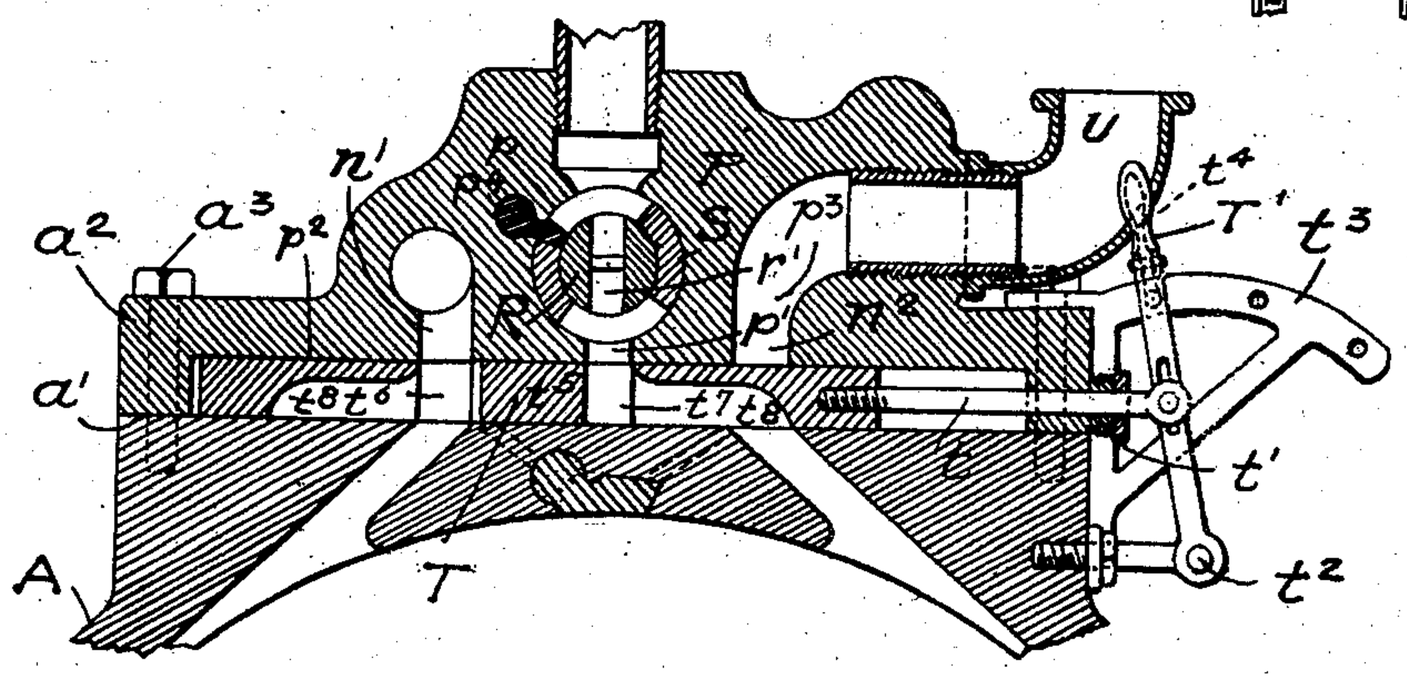
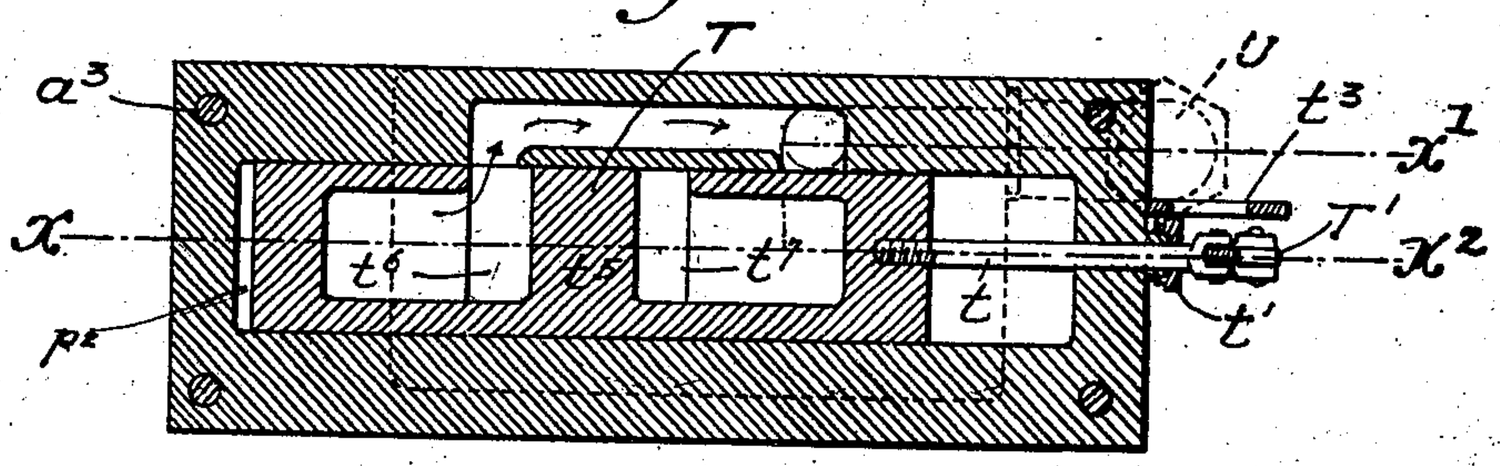


Fig. 7



Witnesses:-
C. H. Schafer.
Geo. M. Meyer

Inventor:-
William L. Casaday.
By his Atty. Wm. H. Rowe.

UNITED STATES PATENT OFFICE.

WILLIAM L. CASADAY, OF SOUTH BEND, INDIANA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 702,624, dated June 17, 1902.

Application filed December 9, 1899. Serial No. 739,737. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM L. CASADAY, a citizen of the United States, residing in South Bend, in the county of St. Joseph and State of Indiana, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates especially to an improved form of rotary engine having a casing wherein two cone-shaped sections with valve-seat and journal extensions thereon are bolted together at their bases and a corresponding cone-shaped hub and engine-shaft supported eccentrically to the casing, and pistons sliding diametrically therein to follow the eccentric inner wall of the casing to drive the engine-shaft.

My invention also relates to a novel form of rotary steam-valve and oscillating cut-off valve and to means for connecting and operating them and also to a novel form of reversing slide-valve and to an improved valve-box for containing said valves especially adapted to and forming part of my improved engine.

My invention also relates to certain details of construction adapted to my invention—viz., to an improved packing for the engine-shaft, to an improved abutment-packing, to an improved piston-packing, to improved means for introducing steam to act upon said packing and to introduce steam behind the sliding pistons, and to certain details of construction and combination of parts hereinafter particularly described with reference to the accompanying drawings, wherein—

Figure 1 is a central vertical longitudinal section of the engine; Fig. 2, a vertical section in line $x\,x$ of Fig. 1, with the valve box and gear in elevation; Fig. 3, an enlarged section of the valve-box in the central line of the valve-stem upon an enlarged scale; Fig. 4, a perspective view of the oscillatory cut-off valve and operating-lever; Fig. 5, a perspective view of the rotary steam-valve and valve-gear. Fig. 6 is a central transverse section taken on Fig. 3; Fig. 7, a horizontal section in line $z\,z$ of Fig. 3, showing the valve and valve-box in section; Fig. 8, a perspective view in detail of the packing for the ends of the piston; Fig. 9, an enlarged section in detail of the check-valve for admitting steam and closing the exhaust to the channels leading to the piston-pockets in the hub for forcing the pistons outwardly, and Fig. 10 is a perspective view of one of the apex abutment-blocks.

The engine-casing A consists of two corresponding sections in the form of cone-frustums A' A^2, each having a sleeve a at its outer truncated ends and a valve-seat a' at the top bolted together, flanges a^2, with bolts a^3 at their base or rim of the sections serving to hold them securely together at the central transverse line of the engine, thus only requiring a single joint, which may be easily and inexpensively fitted up, and dispensing entirely with piston-heads and numerous parts which are liable to become untrue when packed and set up, the axial line of the shaft and wearing-surfaces of the casing being thus deranged in a way which would materially affect the true relationship of the wearing parts of the engine.

The casing A has lugs a^4 on the under sides of the sections A' A^2 and is connected by brackets a^5 with a base A^3 in a suitable manner.

The shaft B is made either separate or cast integral with a double-coned hub B' and is supported in bearings C D of novel construction and is placed eccentric to the axis of the casing, thus providing lune-shaped spaces a^6 between the hub and casing, through which are projected wedge-shaped piston-plates E, which are adapted to slide freely within a pocket b, extending longitudinally through the hub and between the vertical lune-shaped walls a^7 a^7 of the casing, the sides of the piston-plates being parallel and fitted with steam-actuated packing-strips F, fitted in a novel manner to the ends of the piston-plates to bear at all times against the ends of the casing and make a steam-tight connection, while the pistons are allowed to reciprocate freely within the pocket of the hub. The strips F have a beaded side f, which fit within a corresponding groove e in the ends e^2 of the piston to allow the strips to turn slightly therein, as shown in Fig. 8, and when the engine is made reversible two of said strips may be thus employed upon opposite edges thereof. A steam-aperture e' in the pistons adjacent to each of the strips F extends from the

faces of the piston-plates to the grooves *e*, thus admitting steam from the working side of the piston to act upon the strips and press them outwardly with sufficient force to make a steam-tight joint. The straight inner sides e^3 of the pistons have sufficient space in the pocket *b* between them to receive a volume of steam admitted thereto through channels *b'*, extending to the outer surface of the hub B' and fitted with a check-valve G, (shown in Fig. 9,) which has a double seat in the channel and is opened by the steam under pressure to admit steam to the pocket and is closed against the exhaust, said valve being preferably placed in position to the steam admitted from opposite sides of each piston, thus being always closed to the exhaust and open to the steam from whichever direction the engine is turning. The outer side e^4 of the piston-plates are inclined toward the shaft from the center to be parallel to the outer surface of the hub and the inner surface of the casing and bear against the latter, the edges e^5 of the said side e^4 being rounded with a gradually-increasing curvature from the inner to the outer ends thereof, thus to compensate for their gradually-decreasing surface wear and contact from the larger to the smaller diameter of the casing, and thus allowing outer ends of the pistons to wear evenly and keep in constant touch and uniform contact with the inner surface of the casing.

The hub B' conforms to the inner surface of the casing and bears at the top thereof against two abutment-strips H H', each of which has a central bead *h* at the top thereof to fit in a corresponding groove *a* in the casing, which will allow the said abutment-strips to rock or teeter therein, as on a pivot, a steam-aperture *a* in the casing leading to the steam ports near the valve-seat being provided to admit the steam to each side of the bead *h* and above the strips to press the edge of the latter upon the steam side of the abutment and shut off completely the passage of the steam from the steam to the exhaust side of the pistons. Two apex abutment-blocks H^2, as shown in Fig. 10, have pivot ends and are set into corresponding recesses in the casing to fill the space between the ends of the abutment-strips H H', and thus completely bridge and make steam-tight the intersecting surfaces at the base of the double-cored hub. The sleeve *a* of the casing-sections inclose and support the bearings C and D of the hub and shaft-journal K, the latter being formed in a novel manner to comprise stepped sections *k'*, k^2, k^3, k^4, and k^5, the section *k'* being a short extension or conical end of the hub B' and the sections k^2, k^3, and k^4 being substantially of equal width with that of section *k'* and of very slightly coned or cylindrical surfaces and of gradually-decreasing diameters, and the sections k^5 being of greater length and tapering to the outer end of the outer bearing D, thus providing an extended broken bearing-surface for the journal K, which may be kept up to the correspondingly-formed inner surface of the bearings C and D and make a steam-tight journal-bearing which will not bind the journal sufficiently to cause material friction or loss of power incident to the bearings. The bearing C receives the journal-sections *k'* k^2 k^3 k^4, and the bearing D is babbitted and extends from the outer to the inner end of section k^5 and abuts against the outer end of section k^4 and is held and adjusted securely upon the end of the sleeve *a* by set-bolts *d* and is coupled to the outer end of the bearing C by guide-bolts *d'*, projecting from the bearing D into holes in the bearing C, which prevent the bearing C from turning with the journal. A space d^2 between the bearings C and D and an aperture *l'* in the sleeve *a* of the casing are connected by a steam-pipe l^2 with the main steam-pipe L, and a stop-cock l^3 in the pipe l^2 controls the passage of steam through said pipe and allows it to act with a suitable degree of pressure upon the bearing C to hold it closely in contact with the hub and shaft-journal, and thus provide a very simple means for taking up wear and also for exerting any required pressure upon the inner journal-bearing to effectually prevent the escape of steam from the engine through the journal-bearings. The sleeve *a* of the casing has packing-grooves *m* therein to receive hemp or other fibrous packing, and thus guard the outer surface of the bearings from the escape of steam and also allow the bearings to fit with sufficient freedom to be easily adjusted. The inner edge of the bearing C joins the hub B' in the line of the inner surface and the vertical side walls of the casing and at the outer point of the abutment-strips H and holds the steam at the abutment and prevents the steam from leaking at this point when the parts are slightly worn.

Branching ports N lead from the valve-seat *a'* on each side of the abutment to points *n* at the outer ends of the hub and slightly above a horizontal line passing through the axis of the engine-shaft, the valve-seat openings *n'* n^2 being at equal distances from the center line of the engine and upon opposite sides of a port *p'* in the valve-box P and in line with the axis of the pipe L and the center of the rotary steam-valve R and the oscillatory cut-off valves S. The valve-box P has a rectangular chamber p^2 in the bottom thereof, within which slides a flat rectangular box-shaped reversing-valve T, which serves to admit and exhaust steam to and from either side of the engine or completely cut off the steam in whichever position it may be placed by means of a stem *t*, passing through a stuffing-box *t'* in the end of the valve-box and connected to the lever T', pivoted to a pin t^2 on the casing, adapted to be held in any one of three positions by suitable means, a segment-arc t^3 and locking-bolt t^4 being shown in the drawings for this purpose.

The valve T has a central dividing-wall t^5 and ports t^6 t^7 at either side thereof, opening both at the top and at one side of the valve, and chambers t^8 leading from the said ports to within reach of the far side of the valve-seat openings n' n^2, respectively, when the said valve is at either end of its movement, communication being thus obtained between the central steam-port p' and the steam-port upon the one side by means of one of the chambers t^8, and communication also obtained between the said valve-seat openings and the exhaust-port p^3 of the valve-box P through the port t^6 or t^7 in the open side of said port adjacent to the exhaust-port, as clearly shown in Figs. 6 and 7, the said drawings showing the right-hand ports open to the steam and the left-hand ports open to the exhaust. The exhaust-port, as shown in the figures referred to, is formed in the base of the valve-box and extends upwardly to an enlarged circular channel upon either side of the steam-valve and to an exhaust-pipe elbow or connection U, located at one side of and above the valve-gearing.

The steam-valve R fits within the cylindrical bore of the cut-off valve S and has diametric slots therein for the passage of the steam and a collar r^2, which fits snugly within the bore p of the valve-box and of equal diameter with the outer surface of the cut-off valve, thus to completely and snugly fit the said bore, except at the ends thereof, which is packed, a cap r^3 upon the end of the sleeve R', which supports the valve-stem r^4, serving to close one end of the bore p, and a stuffing-box screw-cap R^2 upon the other side of the valve-box serves to take up the packing and also to support the stem S' of the cut-off valve S, thus providing a steam-tight closure for both sides of the open-sided valve-box. The end of the valve-stem has a sprocket-wheel v, driven by a chain V' from a similar wheel v^2 on the engine-shaft, for giving constant rotation of equal number and proper relation to that of the pistons carried by said shaft, the steam-slot r' in the valve presenting its opposite ends to the steam-pipe and steam-ports p', thus giving steam admission for each piston as it passes the steam-port in the casing.

The hub of the sprocket-wheel v^2 has a slot v^3 therein to receive a pin on the engine-shaft, and thus provide means for shifting the relative position of the said valve and shaft when the engine is reversed, as claimed and described more fully in the patent granted to me and dated November 28, 1899, as the valve requires resetting when the engine is reversed.

The cut-off valve S has two oppositely-disposed apertures therein and is oscillated around the steam-valve to expose the steam-slot r' of the steam-valve through a greater or less distance of its movement, and the upper end of said slot receives an abutment-block p^4, projecting therein from the valve-box to a surface contact with the steam-valve, thus to shut off the steam on one side and prevent it from leading back with the aperture of the cut-off valve and securing premature admission to the slot of the steam-valve. The length of the aperture through which the steam-slot travels is thus increased or diminished by oscillating the cut-off valve.

The cut-off valve is oscillated by a lever S^2, affixed to the valve-stem S' and adjustably secured by a latch S^3 to a rack S^4, secured to the valve-box.

The engine thus described is made of parts securely held together, is inexpensive to fit up, and capable of high speed without exposure to leakage at any point, and may be built very light and small without great loss of power or waste of steam, as the cut-off will only admit of the use of sufficient steam to do the amount of work required of the engine.

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

1. A rotary-engine casing comprising two core frustum-shells bolted together at their bases and having eccentrically-disposed journal-sleeves at their truncated ends an engine-shaft and pistons adapted to rotate said shaft and conform to the inner eccentric wall of the casing, substantially as described.

2. The combination with a rotary-engine casing in the form of two cone frustums placed base to base and having journal-bearing sleeves extending eccentrically therefrom, of an engine-shaft having a piston-hub formed of two conical ends adapted to fit the tapering inner wall of the casing and pistons fitted to slide diametrically upon said hub and having outer ends to conform to the surface of said casing, substantially as described.

3. The combination with a rotary-engine casing having two conical ends and bearing-sleeves eccentric thereto of a shaft, a hub having ends to conform to the conical ends of the casing journal-bearings upon the shaft and within the casing sleeves extending to the conical ends of the hub and pistons having their outer ends adapted to fit the angles of the casing and hub and slidably supported in the hub, substantially as described.

4. In a rotary engine the combination with a casing having cone-shaped ends of a shaft and a hub coned to fit the said casing and supported eccentrically thereto, of pistons slidably supported in the hub and having the outer ends thereof inclined to conform to the cones of the casing and rounded on their corners with gradually-increasing curves from the inner to the outer ends thereof, substantially as described.

5. In a rotary engine the combination with a casing, a shaft and hub fitted eccentrically within the casing, piston-plates slidably supported within the hub to project therefrom and having parallel sides to follow the flat lune-shaped ends of the casing and packing-

strips having a bead to fit a corresponding groove in the sides of the piston, substantially as described.

6. In a rotary engine the combination with the casing of a shaft and a conical hub fitted eccentrically thereon, pistons supported and movable therein, abutment-strips pivotally supported upon the oppositely-inclined walls of the casing and apex abutment-blocks pivoted to the casing between the ends of the abutment-strips to bear against the hub and steam-apertures in the casing leading to the back of the abutment-strips and apex-blocks substantially as described.

7. In a rotary engine the combination with a casing having conical ends of a hub correspondingly coned and fitted therein and two abutment-strips pivoted to the casing to bear against the said conical ends of the hub, substantially as described.

8. In a rotary engine the combination with the engine-casing of the shaft and a journal thereon comprising stepped sections and two bearings fitted upon said stepped sections one of said bearings being secured to the casing and the other section adapted to be set up independently thereof and a steam-pipe leading to the space between the said bearings, substantially as described.

9. In a rotary engine the combination with the casing of the shaft and a journal thereon comprising an inner coned section a number of short sections of gradually-decreasing diameter, a self-adjusting bearing adapted to said journal-sections, an outer conical journal-section and a bearing adjustably secured to the casing and adapted to the outer cone-shaped journal-section, substantially as described.

10. In a rotary steam-engine the combination of a casing a shaft, a hub and piston having cone-shaped ends an abutment-strip extending to the end of the hub a shaft-journal having an inner cone extension from the conical end of the hub and a bearing adapted thereto and extending to the end of the said abutment-strip, substantially as described.

11. In a rotary engine, the combination with the casing of the rotary shaft and hub located eccentrically to the inner wall of the casing, slidable pistons carried thereon, a steam-chest, a steam-pipe leading to the top thereof, a rotary steam-valve having a slot passing diametrically through the same, an oscillatory cut-off valve adapted to the steam-valve, and a slide reversing-valve located between the steam-valve and steam-ports having ports leading both vertically and laterally therein, and a valve-chamber having ports leading from the lateral ports of the slide-valve and across the axis of the steam-valve.

12. In a rotary engine, the combination with the casing, of the rotary shaft, the rotary pistons, and the rotary steam-valve geared to the said shaft, and having a slot passing diametrically through the same, the oscillatory cut-off valve adapted to the steam-valve, having ports located upon opposite sides thereof, a valve-box having a steam-pipe leading to the outer one of said ports, and an abutment-block upon the valve-box projecting through the said outer port and bearing upon the outer surface of the steam-valve.

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