

3 Sheets—Sheet 1.

No. 586,895.

Patented July 20, 1897.

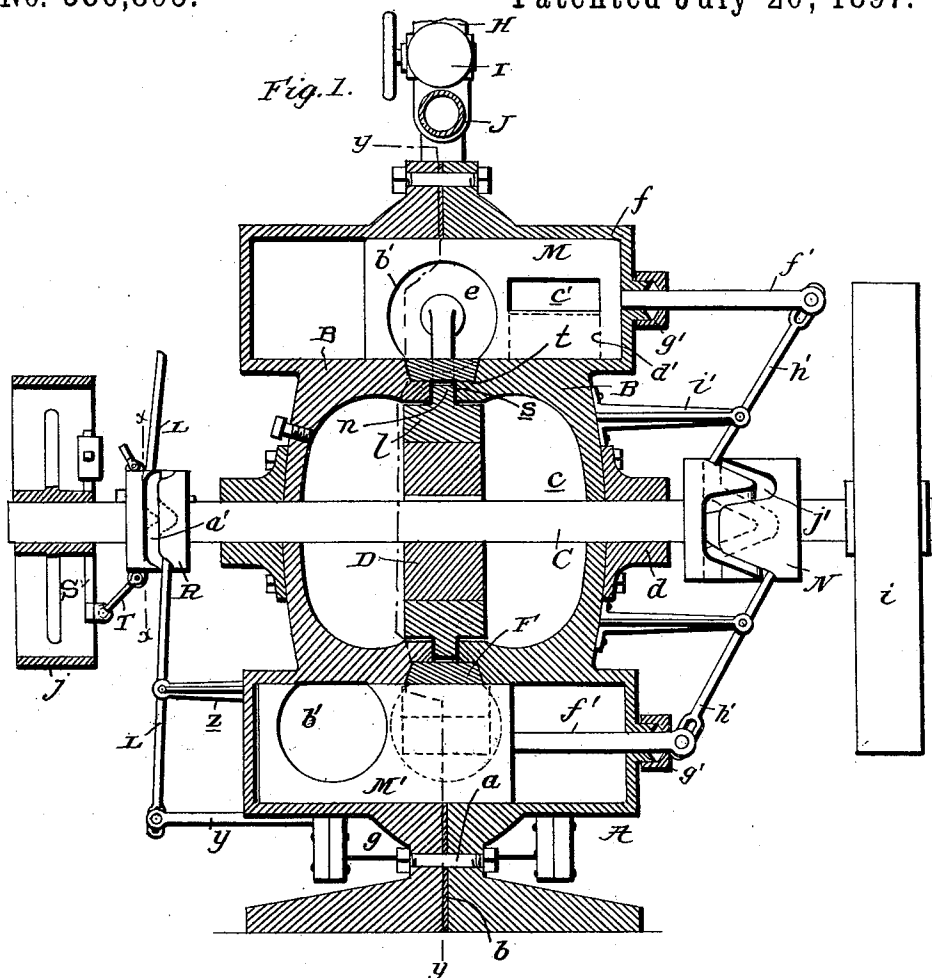
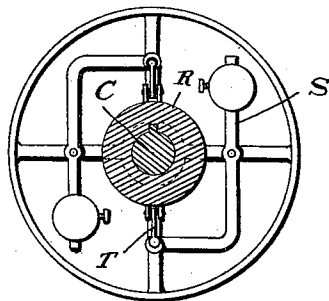


Fig. 2.



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(No Model.)

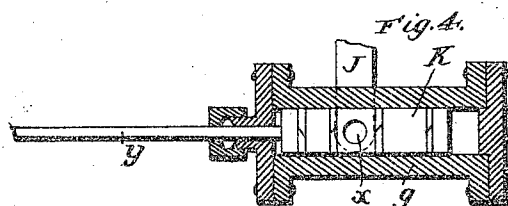
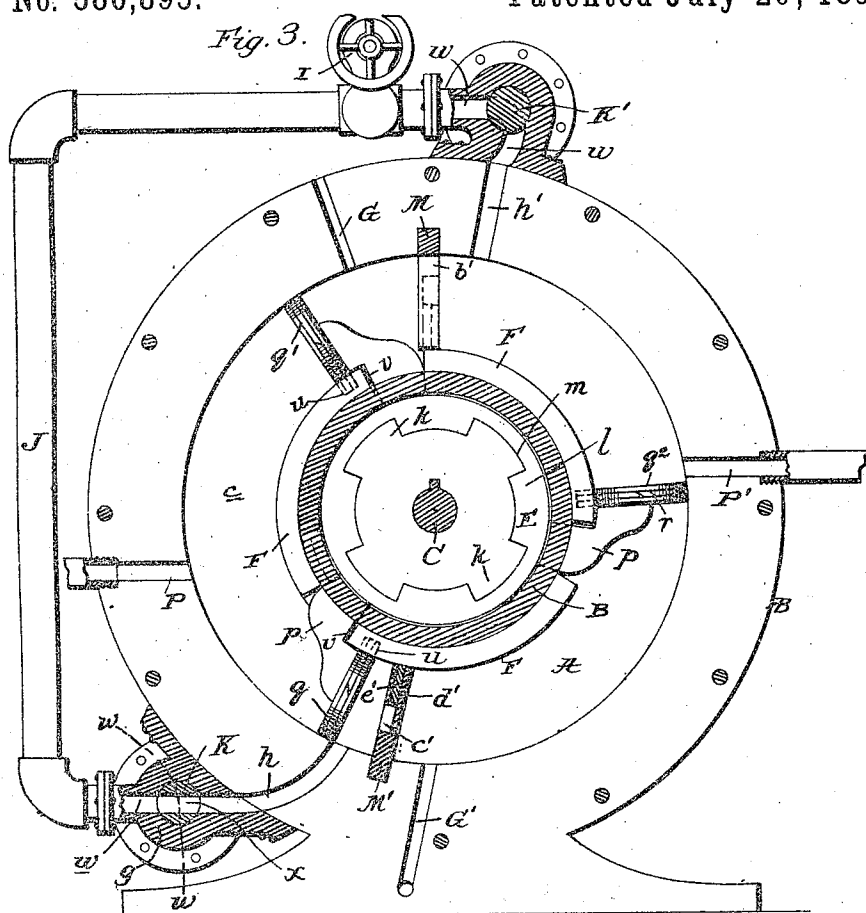
3 Sheets—Sheet 2.

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ROTARY STEAM ENGINE.

No. 586,895.

Patented July 20, 1897.



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3 Sheets—Sheet 3.

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Fig. 5.

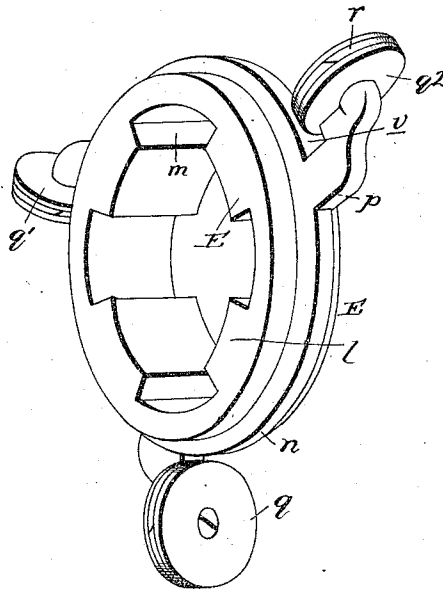


Fig. 6.

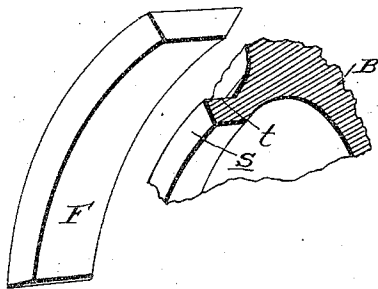
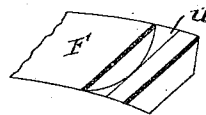


Fig. 7.



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UNITED STATES PATENT OFFICE.

CHARLES A. CALLENDER AND EMIL W. PARNO, OF GREENE, IOWA.

ROTARY STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 586,895, dated July 20, 1897.

Application filed March 2, 1897. Serial No. 626,703. (No model.)

To all whom it may concern:

Be it known that we, CHARLES A. CALLENDER and EMIL W. PARNO, citizens of the United States, residing at Greene, in the county of Butler and State of Iowa, have invented certain new and useful Improvements in Rotary Steam-Engines; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to improvements in rotary steam-engines; and its novelty and many advantages will be fully understood from the following description and claims when taken in conjunction with the accompanying drawings, in which—

Figure 1 is a vertical transverse section of our improved engine with some of the parts broken away. Fig. 2 is a detail section taken in the plane indicated by the line *xx* of Fig. 1 and illustrating the governor. Fig. 3 is a vertical longitudinal section taken in the plane indicated by the line *yy* of Fig. 1, with some of the parts in elevation. Fig. 4 is a detail section taken in the plane indicated by the line *ww* of Fig. 3. Fig. 5 is a detail perspective view of the piston removed. Fig. 6 is an enlarged sectional perspective view illustrating a portion of one casing-section and one of the segmental packing-bars; and Fig. 7 is a detail perspective view of one end of the packing-bars, illustrating the recess therein for the reception of one of the blades of the piston.

In the said drawings similar letters designate corresponding parts in all of the several views, referring to which—

A indicates the casing of the engine, which is preferably formed by two longitudinal cast-metal sections B, connected by transverse bolts *a*, with a Babbitt-metal packing *b* between them, and comprises the central air-chamber *c*, with journal-bearings *d* on opposite sides of the same, the annular piston-chamber *e*, in which the blades of the piston are arranged and adapted to move, the gate-casings *f*, which intersect the annular chamber *e*, and the valve-casings *g*, which are connected by parts *h* with the annular piston-chamber *e* at the points better illustrated in Fig. 3.

C indicates the central shaft of the engine, which is journaled in the bearings *d* and is preferably provided with a balance or fly wheel *i* at one end and a pulley *j* at its opposite end.

D indicates a disk wheel which is keyed or otherwise fixed to the shaft C and is provided with dovetail projections *k* upon its periphery, and E indicates the piston, which comprises the annular portion *l*, having dovetail recesses *m* for the reception of the projections *k* of the disk wheel, so as to fix the piston with respect to the shaft, and also having the longitudinal central rib *n* upon its periphery, the radial arms *p*, extending between the contiguous edges of the casing-sections B and into the annular chamber *e*, and the pistons *q* *q'* *q''* on the arms *p*, which are preferably of circular form in conformity to the shape of the chamber *e* in cross-section and are preferably provided with suitable packing-rings *r*, as shown.

The inner portions of the casing-sections B have their edges arranged about the proportional distance illustrated apart to afford a play-space *s* for the arms *p* of the piston, and they also have their portions between the play-space *s* and the annular piston-chamber *e* rabbeted, as better shown in Fig. 1, to form a seat *t* for the reception of the segmental packing-bars F, of suitable metal, which are of a size and shape in cross-section to snugly fit said seat *t*, as shown. These bars F are provided with recesses *u* to snugly receive the blades *q* *q'* *q''* of the piston E, and they have their forward ends resting in recesses *v* in the arms *p* of the piston-blades and their rear ends abutting against the arms *p* of the following piston-blades, as shown in Fig. 3, whereby it will be seen that they will move with the piston, for a purpose herein after to be pointed out.

G G' indicate ports which connect the annular piston-chamber *e* and the open air.

H indicates a steam-supply pipe, which is provided with a throttle-valve I and is connected with a generator. (Not illustrated.)

J indicates a pipe connecting the pipe H with ports *w* in the valve-casings *g*, and K K' indicate slide-valves arranged in the casings *g* and provided with ports *x* for effecting communication between the ports *w*, *h*, as

shown at the bottom of Fig. 3. These valves K K' have their stems y connected to levers L, which are fulcrumed at an intermediate point of their length on stationary arms z and have their inner ends arranged in the peripheral cam-slot a' of the disk R, feathered on the shaft C, so as to turn therewith and slide thereon, whereby it will be seen that when the shaft C and the disk R are rotated the valves will be alternately opened and closed, the cam-slot a' being so formed and the levers L being so arranged therein that when the valve K is open the valve K' will be closed, and vice versa, for a purpose presently described.

In order to regulate the speed of the engine, we provide, in conjunction with the disk R, a centrifugal governor, which preferably comprises the weighted arms S, fulcrumed on the spokes of pulley j , and links T, connecting said arms and the disk R, whereby it will be seen that when the speed is so great as to throw the weighted ends of the arms outwardly a certain extent the disk R will be moved so as to more or less close the steam-outlet passages through the valves, and consequently reduce the speed of rotation of the engine.

M M' indicate transversely-movable partitions or gates which are arranged in the casings f , intersecting the annular piston-chamber e . These partitions or gates have openings b' , corresponding in shape and size to the shape of the chamber e in cross-section, and they also have the recesses c' (see Fig. 3) in one of their faces, and the openings d' , extending from said recesses to their inner edges and designed to receive packing-strips e' , the said strips e' being adapted, when the gates are moved into a position to partition the annular piston-chamber e , to be pressed by the steam against the packing-bars F, so as to prevent the passage of steam from one compartment of the chamber e into another.

At one end the gates or movable partitions M M' are connected to stems f' , which extend through stuffing-boxes g' and are connected to the outer ends of levers h' , which are fulcrumed on stationary arms i' , and have their inner ends arranged in a cam-groove j' in a disk N, fixed on the shaft C, as shown, the said cam-groove j' being so formed and the levers h' being so arranged that when the gate M is open the gate M' is closed, and vice versa, and being also so arranged and timed that when the valve K is open the gate or partition M' will extend across and close the chamber e . When said valve K is closed, the gate or partition M' will occupy such a position that its opening b' registers with the chamber e . When the valve K' is open, the gate or partition M will extend across and close the chamber e , and when said valve K' is closed the gate or partition M will occupy such a position that its opening b' registers with the chamber e .

P P' indicate exhaust-ports, which are arranged at about the points shown and communicate with the chamber e .

The practical operation of the engine will be fully understood from the following description. With the parts in the position shown in Fig. 3, when the throttle-valve I is opened steam passing through the pipe J, valve K, and port h will act against the piston-blade q and rotate the piston in the direction indicated by arrow a sufficient distance to carry the piston-blade q' through the opening b' of gate M and past the port h' . When the piston-blade q' passes the port h' , the valve K will have been closed, the gate M' opened, the valve K' opened, and the gate M closed. Steam will now enter through the port h' , and, acting against the blade q' , will rotate the piston a sufficient distance to carry the blade q'' past the port h , when the parts will assume the position shown in Fig. 3, when the operation before described will be repeated, with the exception that the steam entering through the port h will act against the blade q'' instead of the blade q' . In other words, as each blade of the piston passes the ports $h h'$ the gates in rear of the said ports will be automatically closed and the steam-valves will be automatically opened, so as to permit the steam to enter between the gates and the blades and drive the piston in the direction indicated by arrow. As each piston-blade passes the exhaust-ports P P' the steam back of the said blades, having performed its function, passes out through said ports, so as not to cushion or retard the forward movement of the succeeding piston-blades, while the air in front of the said piston-blades finds free egress through the ports G G', and consequently does not tend to retard the rotation of the piston.

The segmental packing-bars F form a highly-important feature of our invention inasmuch as they serve effectually to prevent leakage of the steam from the chamber e through the space s between the casing-sections B, with but a minimum amount of friction between the piston and the casing. Said bars F rest loosely between the arms p of the piston E and bear loosely upon the casing-sections B, and consequently there is practically no friction between the bars F and the casing-sections except when the bars are in action—that is to say, when steam is acting against the piston-blade beneath and in rear of which the bar extends. When steam is acting against the piston-blade beneath and in rear of which a bar F extends, said bar will be pressed and held tightly in its seat by the tendency of the steam to escape through the space s and will effectually prevent such escape of steam, and as the steam is acting against but one piston-blade at a time the other two bars F will bear loosely against the casing-sections B and will not add materially to the friction, which is a highly-important advantage.

The chamber *c* of the casing *A* is designed to be an air-chamber.

From the foregoing it will be observed that our improved engine is very simple and compact, that the parts are adapted to be quickly and easily put together, and that there are no complicated parts to get out of order after a short period of use.

It will also be observed that there is but a minimum amount of friction incident to the rotation of the piston and that therefore the power which would otherwise be expended in overcoming friction is utilized to assist in the rotation of the piston, which renders the engine highly desirable from an economical standpoint.

We have in some respects specifically described the construction and relative arrangement of the parts of our improved engine in order to impart a full, clear, and exact understanding of the same. We do not desire to be understood as confining ourselves to such specific construction and arrangement of parts, as such changes or modifications may be made in practice as fairly fall within the scope of our invention.

Having thus described our invention, what we claim is—

1. In a rotary engine, the combination of a casing having an annular chamber and an opening or space at the inner side of said chamber and also having inlet and exhaust ports for steam, a rotary piston extending through said opening or space and provided within the annular chamber with blades, automatic valves controlling the steam-inlet ports, automatic gates or partitions for dividing the annular chamber, and a plurality of separate packing-bars resting loosely within the annular chamber and over the opening or space at the inner side of said chamber and arranged between the blades of the piston and having their forward portions connected and movable with the blades and their rear portions loose, substantially as and for the purpose set forth.

2. In a rotary engine, the combination of a casing having an annular chamber and an opening or space at the inner side of said chamber, a rotary piston extending through the said opening or space and provided within the annular chamber with blades, and suitable packing-sections resting loosely within the annular chamber and over the opening or space at the inner side thereof and connected at one end to and movable with the piston-blades and having their opposite ends

loose; said packing-sections being adapted to be pressed by steam against the casing so as to prevent the escape of steam through the opening or space at the inner side of the annular chamber, substantially as specified.

3. In a rotary engine, the combination of a casing having an annular chamber and an opening or space on the wall of the chamber, a rotary piston extending through said opening and provided within the annular chamber with blades, and the metallic packing-bars conforming in curvature to the wall of the annular chamber and arranged in said chamber over the opening or space in the wall thereof and having recesses adjacent to one end receiving the blades of the piston and their opposite ends loose; said bars being adapted to be pressed by steam against the casing so as to prevent the escape of steam through the opening or space in the wall of the annular chamber, substantially as specified.

4. In a rotary engine, the combination of a casing having a central air-chamber, an annular piston-chamber surrounding the air-chamber and provided with a space or opening and a seat *t*, in its wall at the inner side thereof, casings intersecting the annular chamber, and inlet and exhaust ports for steam, a shaft journaled in the casing and extending through the air-chamber, a rotary piston fixed with respect to said shaft and extending through the opening or space on the wall of the annular chamber and provided within said chamber with blades, valves for automatically opening and closing the steam-inlet ports, gearing intermediate of the shaft and said valves, gates or partitions, for dividing the annular chamber, provided with openings corresponding in shape and size to the annular chamber, gearing intermediate of the shaft and the gates or partitions, and metallic packing-bars loosely arranged in the seat *t*, of the annular chamber over the opening or space in the wall thereof and also arranged between the blades of the piston and provided adjacent to one end with recesses receiving the piston-blades and having their opposite ends loose, substantially as specified.

In testimony whereof we affix our signatures in presence of two witnesses.

CHARLES A. CALLENDER.

EMIL W. PARNO.

Witnesses:

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C. E. MABEE.