No. 676,687. Patented June 18, 1901.

A. S. PIATT.

ROTARY ENGINE.

(Application filed Mar. 9, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

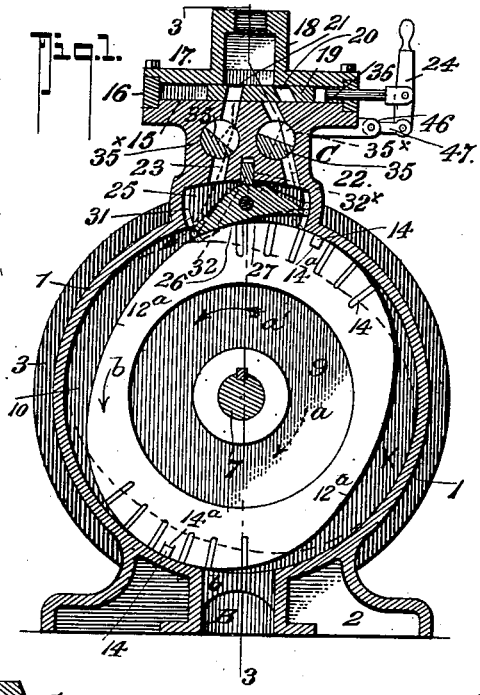


Fig. 3.

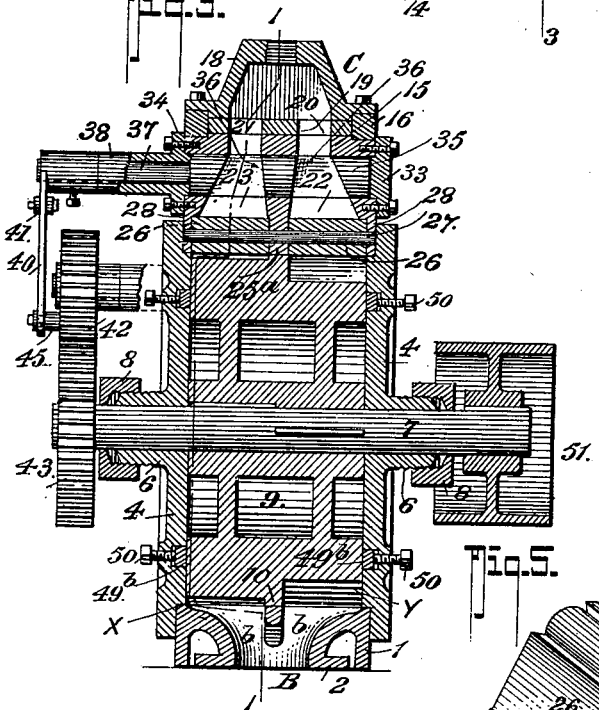


Fig. 4.

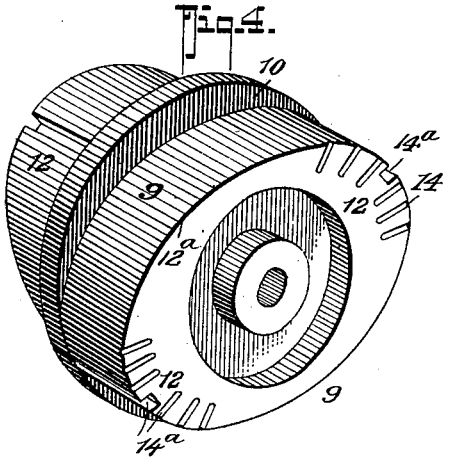
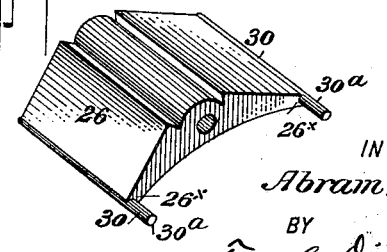


Fig. 5.



WITNESSES:

Louis Dieterich

L. Wentzell

INVENTOR

Abram S. Piatt

BY

Fred G. Dieterich & Co.

ATTORNEYS

No. 676,687. Patented June 18, 1901.

A. S. PIATT.

ROTARY ENGINE.

(Application filed Mar. 9, 1900.)

(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

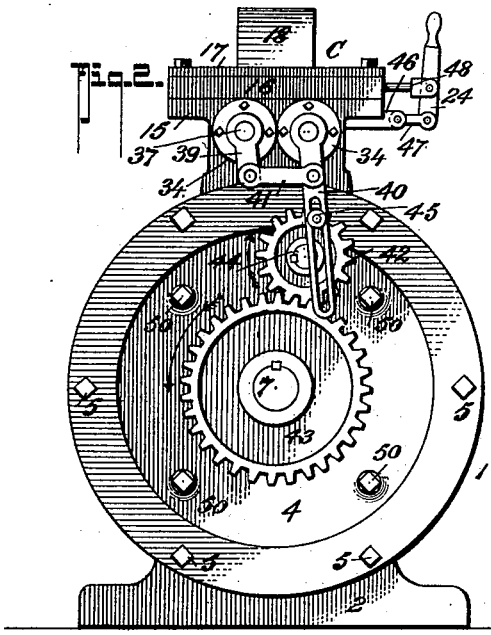


Fig. 6.

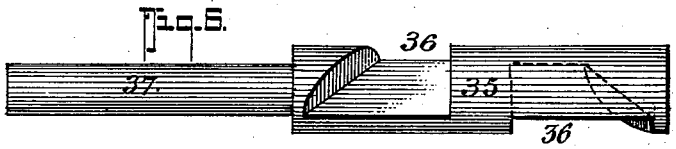


Fig. 7.

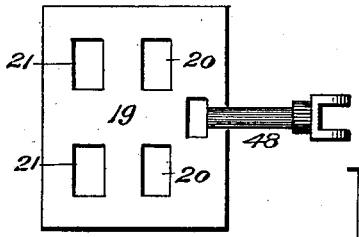


Fig. 8.

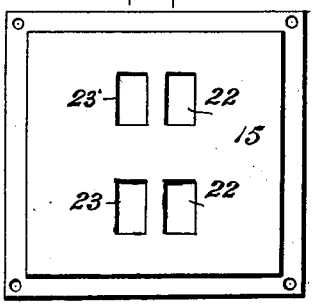
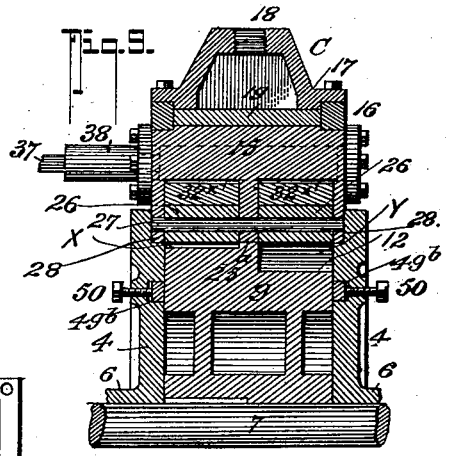


Fig. 9.



WITNESSES:

Louis Dieterich

L. Wentzell

INVENTOR

Abram S. Piatt

BY

Fred G. Dieterich & Co

ATTORNEYS

UNITED STATES PATENT OFFICE.

ABRAM S. PIATT, OF WEST LIBERTY, OHIO.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 676,687, dated June 18, 1901.

Application filed March 9, 1900. Serial No. 7,982. (No model.)

To all whom it may concern:

Be it known that I, ABRAM S. PIATT, residing at West Liberty, in the county of Logan and State of Ohio, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to improvements in that type of rotary engines embodying generally a casing having a pair of annular steam-chambers discharging into a single exhaust, a single steam-feed, a steam-chest having laterals discharging into the said chambers, cut-off-valve mechanism automatically controlled for leading the live steam to the two steam-chambers alternately, and a concentrically-traveling piston in each chamber, but mounted upon a single drive-shaft adapted to travel in unison, but having abutment-surfaces arranged oppositely, whereby as one piston in one of the steam-chambers is being propelled under live-steam force the other is moving to the finish of its stroke under steam expansion, and vice versa.

My invention particularly seeks to provide a new and novel construction of engine of this type, capable of being economically produced, compactly arranged, which will operate effectively and under a great power capacity with a minimum amount of boiler-pressure and, in which the cut-off devices and the piston construction are especially arranged to operate with a minimum waste or leakage.

My invention consists in certain combinations and detailed arrangement of parts, all of which will hereinafter be fully explained, and particularly pointed out in the appended claims, reference being had to the accompanying drawings, in which like characters indicate like parts in all the figures thereof.

Figure 1 is a vertical section of my improved engine, taken practically on the line 1 1 of Fig. 3. Fig. 2 is a side elevation of the same. Fig. 3 is a transverse section taken substantially on the line 3 3 of Fig. 1. Fig. 4 is a perspective view of the double piston. Fig. 5 is a detail perspective view of one of the automatically-shifting tilting valves. Fig. 6 is a detail view of one of the cut-off valves. Fig. 7 is a plan view of the reversing-valve. Fig. 8 is a plan view of the steam-chest face, and Fig. 9 is an enlarged detail sectional view of that part of the casing in which the upper or steam-chest portion fits.

In its practical construction my improved engine comprises a casing formed with a single annular compartment, the lower end of which has a divided exhaust *b*, that discharges into the single exhaust or offtake B, that forms a part of the base portion 2 of the casing 1. The cylindrical casing 1 has the usual flanges 3, to which the cover or end plates 4 are secured by the bolts 5 in any approved manner, and the said end plates have central bearings 6 6 for the drive-shaft 7, which is arranged concentrically within the casing 1.

8 indicates suitable bearing glands or caps threaded on the opposite ends of the drive-shaft 7 to form steam-tight joints, and on one end the shaft carries the drive-pulley 51, its other end having a master-gear 43 mounted thereon, the reason for which will presently appear.

9 indicates the piston, the peculiar construction of which and its coöperative combination with the shifting valves and the cut-off valve forms the essential feature of my invention, and the same consists of a single member keyed to the shaft 7 and having a width to snugly fit with its ends against the end caps of the casing, with which it is held steam-tight by means of the packing-rings 49^b, that fit in the grooves in the casing-heads and which are adjustably fitted by the set-screws 50, as clearly shown in Fig. 3, and to lighten the weight of the said piston the same may be cored out, as shown in the aforesaid figure.

The piston 9 has a central annular rim portion or flange 10, having a diameter to accurately fit and turn on the central portion of the bore of the casing 1, whereby to divide the said bore into two independent compartments, (indicated by *x* and *y* in the drawings,) each of which communicates, through the ports *b b*, with the single exhaust B. At each side of the central flange 10 the piston 9 has oval-shaped peripheries 12, the peripheral members 12 at each side being disposed at diametrically opposite points. The ends of the piston peripheries 12 have a circle concentric with the annular wall of the steam-compartments, whereby to ride closely against said

wall and form, as it were, each separate steam-compartment x and y into two spaces to adapt the engine for reverse running, as will presently more fully appear. The peripheral members 12 on the one side are arranged at right angles to the peripheral members 12 on the other side of the piston. In other words, the four members 12 are disposed quarterly, whereby as the steam-feed changes from one side of the piston to the other a live-steam pressure will be entered against the piston upon each quarter of its revolution and providing for propelling the piston on the downgoing side at all times under a full head of live steam on the one side the first quarter of its forward movement, as the other side of the piston is being carried over the second quarter of its movement under steam-expansion in the space in which it turns. Thus the piston is at all times being driven forward under a combined live and expansive steam force, the live steam entering first on one side and then on the other, while the expansive steam likewise reversely acts on the said two sides of the piston.

By making the piston of a single member constructed in the manner described a uniform action of the engine is obtainable with a minimum live-steam feed for the reason that even under changes of pressure on the opposite sides, the piston being one solid part, danger of irregular piston action within the two steam-spaces, which is incident in this type of engines having separate piston members in each compartment, is entirely avoided. Furthermore, the cost of building the engine is materially less than is the case where the bore of the casing has a fixedly-held partition and two separate pistons are made fast to a single drive-shaft, the assembling of the several parts being by reason of the construction set forth made the more simple, convenient, and expeditious, a great saving of boiler-pressure being also effected.

The edges of the members 12 merge with the segmental surfaces or curves 12^a, struck on a radius equal to that of the bore of the casing or cylinder, for reasons hereinafter explained, and the said edges 12 have suitable water-grooves on their peripheral faces, the ends of which contact or ride against the inner surfaces of the heads or cover-plates 4. To further provide for a steam-tight joint, packing-strips 14 are fitted in the grooves 14^a, as shown.

The top part of the engine is preferably fitted upon the casing or cylinder portion and made fast thereto in any approved manner, or it may be made integral therewith. For conveniently fitting the shifting valve devices presently referred to in position I prefer to make the body of the engine as shown in Fig. 3, by reference to which it will be seen the bottom of the top part C seats on the inner flanged portions of the heads 4.

The steam-chest face 15 is formed integral with the top portion C, and said portion C also includes the steam-chest 16 and steam-chest cover 17, and integrally with the latter is the inlet-boss 18, into which the supply-pipe discharges.

19 designates a flat manually-operated reversing slide-valve which accurately fits and is adjustably held to slide between the true faces of the members 15 and 17, as best shown in Fig. 1, and the said valve 19 has ports 20 and 21. (See Fig. 7.)

22 and 23 designate the steam-admission ports, of which there is one pair for each independent steam-compartment x and y, which extend down from the steam-chest and discharge to the opposite ends of the spaces x and y, as clearly shown in Fig. 9, to rotate the piston in opposite directions when the valve devices are properly set for such purpose, such distribution of the steam being effected by the slide-valve 19, which when it is required to rotate the piston toward the right, as indicated by arrow a, is moved by the reversing hand-lever 24 until the ports 20 register with the steam-chest ports 22, and when the opposite piston rotation is required the valve 19 is shifted until the ports 20 register with the ports 23, and when it is desired to stop the engine the valve 19 is shifted to a midway position to bring its ports 20 to partially uncover both ports 22 and 23 and thereby admit steam on both sides of the piston, and by reason of the steam equilibrium on both sides the piston will remain at rest.

In the lower end of the upper or valve-holding end of the casing are formed two pockets 25, separated by a pendent flange 25^a, (see Fig. 3,) the lower edge of which forms practically a continuation of the casing-bore. Within each space 25 are mounted a pivoted balance or automatically-operating shifting valves 26, one of which is shown in detail in Fig. 5. The valves 26 are of a shape to accurately fit within the pockets 25 to form a steam-tight joint. The two valves 26 are centrally supported upon a single rod 27, journaled in the central pendent member 25^a and the end ribs or flanges 28 of the upper casing portion, said members 25^a and 28 having registering apertures, into which the rod 27 can be readily slipped before the top port of the casing is fitted on the bottom or main portion thereof, and the said rod 27 is held from moving endwise by end plates or heads 4 when the several parts are in an operative position, as clearly shown in Fig. 3. The opposite ends of the valves 26 have transversely-extending concaved seats $26^\times$, and in each seat is fitted an antifriction-roller 30, of a length greater than the width of the valves 26, to provide projecting ends 30^a to engage with segmental grooves 31, formed in the adjacent sides 29 and 28. (See Figs. 1 and 5.)

The under sides of the shifting valves 26, held to rock on the rod 27, are curved on an arc of a circle equal that of the bore of the steam-chamber, whereby when the cam ends of the pistons pass thereunder, the said

valves will fit snugly down against the piston cam ends, as will presently more fully appear.

In the operation of the balanced shifting valves 26 the antifriction-rollers 30 rotate and are alternately brought into contact with the cam or peripheral surfaces 12 of the pistons. The upper face of each of the pivotal or central parts of the valves is rounded concentrically with pivotal axis of the valve, whereby to form true bearing-surfaces for the bottom or bearing edges of the packing-strips 32, that fit in the grooves $32^{\times}$, so as to make steam-tight joints.

By making the under face of the valves 26 on the same curvature as the convex peripheral faces 12 of the piston as each of the said faces 12 passes under its respective pivoted valve 26 close contact between the two parts aforesaid is obtained and steam is prevented from escaping into the exhaust side of the cylinder 1. The antifriction-rollers 30, which are set to bear against the pistons, serve to reduce the friction between valves 26 and the pistons to a minimum, and thereby to a great extent relieve the valves 26 of a rubbing friction and also add to the efficiency of the engine.

The antifriction-rollers 30 are extended laterally from the valves 26, and their extended ends engage with the segmental slots 31, and the said slots are provided for the purposes of maintaining the rollers 30 in proper engagement with the valves 26.

At a point between the valves 26 and the steam-chest face 15 cylindrical valve-seats $35^{\times}$ are formed in the steam-passages to the cylinder, which extend entirely through that part of the casing, the ends of said seats $35^{\times}$ being closed by the covers 33 and 34, bolted to the top part of the engine-casing, as clearly shown in Figs. 2 and 3. In each seat $35^{\times}$ is held a rotary valve 35 (shown in detail in Fig. 6) and comprises a valve end proper having two oppositely-disposed recesses 36, adapted to alternately register with the steam-inlets that communicate with the steam-passage in which the valves 26 are seated, it being understood that one valve 26 coöperates with the inlet-ports 22 and 23 that open to one side of the engine-cylinder, while the other valve similarly coöperates with inlet-ports 22 and 23 that open into the other side of the cylinder.

Assuming, for instance, the piston to be rotating from right to left, as indicated by the arrow a' in Fig. 1, and the piston 9 in the position shown in the said Fig. 1, the valve-recess at this time would be in a position closed from the end X of the cylinder, the piston member in said end at this time being moved under a forward pressure by expansive steam force against it in the direction of the arrow b, while the recess or port 36 over the other port 23, corresponding with the (mate) first port 23, will be in position to open up a communication from the steam-chest to admit live steam into the right-hand end of the cylinder in Figs. 1 and 2, (see dotted arrow in Fig. 1,) feeding until a live force against the member 12, now in the left-hand side, Fig. 1, of the end Y of the cylinder, it being understood that when the engine is under the conditions stated the valve 26 for the end X of the cylinder has the position shown in full lines in Fig. 1. The valve 26 in the end Y of cylinder has the position shown in dotted lines in the said figure, the several parts shifting to alternate positions twice during a complete rotation of the piston, whereby live steam is properly distributed against the piston at each quarter of its stroke.

The stems 37 of the valves 35 extend through bearing-sleeves 38, integrally formed on the cover members 34, and on one end of one of the levers 35 is fixedly secured a crank-lever 39, while the other lever end 37 has fitted to it a slotted pendulum-lever 40, which connects with the lever 39 through the media of a connecting-rod 41, whereby to cause the two members 39 and 40 to swing in unison and move both valves simultaneously, the two valves 35 being similarly arranged, but only the one in line with the live-steam passage is brought into an operative action.

The master-gear 42 on the drive-shaft meshes with a smaller gear 43, journaled on the stud-bearing 44 on that casing-cover adjacent the gear 42, and the said gear 43 has a stud or wrist-pin 45, that extends through the slot of the oscillating lever 40.

In the practical construction of my invention the proportion of diameter of wheel 43 to that of 42 is such as to produce the required number of oscillations of the pendulum-like lever 40 to each revolution of the piston 9, the ratio in the present case being one to two, there being only two periods of steam admission and cut-off on each side of the piston or four steam admissions and cut-offs for the entire piston at each complete revolution of the engine.

46 designates a fulcrum-bolt on the end of the steam-chest face-casting, to which is pivotally connected one end of a link 47, the other end of which pivotally joins with the lower end of the hand-lever 24, to which the valve-rod 48 of the slide-valve 19, having the ports 20 21, connects, as clearly shown in Fig. 7.

From the foregoing description, taken in connection with the accompanying drawings, it is thought the complete operation and the advantages of my improved construction of engine will be readily understood.

One of the main advantages of my invention is that by using a single piston which has an integral member that acts as a means for dividing the cylinder into two distinct compartments and making the two ends each to act as an independent piston-head and the said two working on opposites or alternately and providing a pair of cut-off valves for keeping the live steam from passing over to

the exhaust side and making the under side of said valves on a perfect circle segment, so the piston can travel smoothly under it, a very compact, regular, and efficient action of the several parts is secured.

The correlation of the several parts and the construction of each of the coöperating parts are such as to render their manufacture easy and economical, as well as providing for readily assembling them into an operative condition.

The segmental grooves 31 in the casing on either side of the steam-collecting space 25 hold and allow the valves 26 to play steadily and at the bottom to quarterly relieve pressure on the face of the piston, thus reducing friction.

The pendulum or slotted lever 40 serves to properly set the valves 35 at predetermined intervals to change the steam to first engage the piston at one end to drive it forward and then on the opposite end to continue to propel it in the said direction.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A rotary engine, comprising a single-bore cylinder, having two separate feed-inlets opening into the top thereof, and a single exhaust, a steam-chest, having two sets of steam-passages 22 and 23, communicating with the cylinder-feed inlets, a double-acting valve in each set of steam-passages, adapted to alternately open up the said passages 22 and 23, to the cylinder, a single concentrically-operating piston, said piston including a central portion having its peripheral edge closely fitting the bore of the cylinder, whereby to divide it into two independent compartments, and having each end of a reduced diameter and terminating in two diametrically opposite ends whose peripheral edges are made to ride steam-tight over the annular cylinder-surface, automatically-operating valves for engaging the pistons, said valves forming swinging abutments, and mechanism connecting the valves in the steam-passages with the drive-shaft, adapted to automatically shift the said steam-supply-controlling valves at predetermined intervals, all being arranged substantially as shown and described.

2. In a rotary engine, the combination with the cylinder, steam-passages 22 and 23, discharging in the same direction into the cylinder, the double valve 35, for controlling the steam lead to the said passages 22 and 23, said cylinder having an exhaust at a point opposite the inlets; of the concentrically-rotating drive-shaft, the piston 9, mounted thereon, said piston consisting of a single body, having a central annular flange 10, and the reduced ends, said ends terminating in members 12, having their peripheral faces curved to engage the annular wall of the cylinder, the peripheral portions at one side being disposed at a right angle to those on the other side, and swinging abutments independently operating and adapted to coact with the peripheral piston portions, substantially as shown and for the purposes described.

3. A rotary engine comprising in combination, a casing having a single cylindrical chamber or bore, a single exhaust therefor, a pair of vertically-extended spaces above the bore, diametrically opposite the exhaust, an automatically-operating tilting valve mounted in each of said spaces, having the under face curved to form an accurate continuation of the annular cylinder-wall, a pair of steam-passages 22 and 23, discharging upon each end of the tilting valves, a double-acting valve 35, for each pair of passages 22 and 23, means controlled by the drive-shaft for shifting the valves 35 at predetermined intervals, whereby to lead the steam alternately first through the passage 22, and then through the passage 23, a reversing-valve, for changing the feed of steam to the opposite sides of the piston, a shaft concentrically mounted in the cylinder, and a piston mounted thereon, said piston having opposite ends of reduced diameter terminating in elongated peripheral members 12, the members 12 on one end being at right angles to the members 12 on the other end, all being arranged substantially as shown and for the purposes described.

4. In a rotary engine, the combination of a cylinder provided with steam inlet and outlet passages, a piston rotatably mounted therein, a valve-pocket connected with the receiving-inlet, segmental grooves in opposite sides of the valve-pocket and a valve centrally pivoted between the segmental grooves, said valve provided at each end with a concave bearing and an antifriction-roller, the ends of the rollers adapted to operate in the segmental grooves of the valve-pocket, as set forth.

5. In rotary steam-engines, a steam-cylinder having a steam-inlet, a top steam-receiving recess or pocket provided at opposite sides with segmental grooves, a lower exhaust-opening, closing-covers on the ends of the cylinder, a piston having its axis concentric with the axis of the cylinder but of smaller diameter, the piston provided with peripheral projections contacting with the interior of the cylinder; a valve centrally pivoted within the steam-receiving pocket of the cylinder, said valve provided at its ends with concave bearings and antifriction-rollers, the ends of said rollers adapted to operate in the segmental grooves of the steam-receiving pocket, substantially as and for the purpose specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ABRAM S. PIATT.

Witnesses:
J. T. SHUGH,
VAN B. BAILEY.