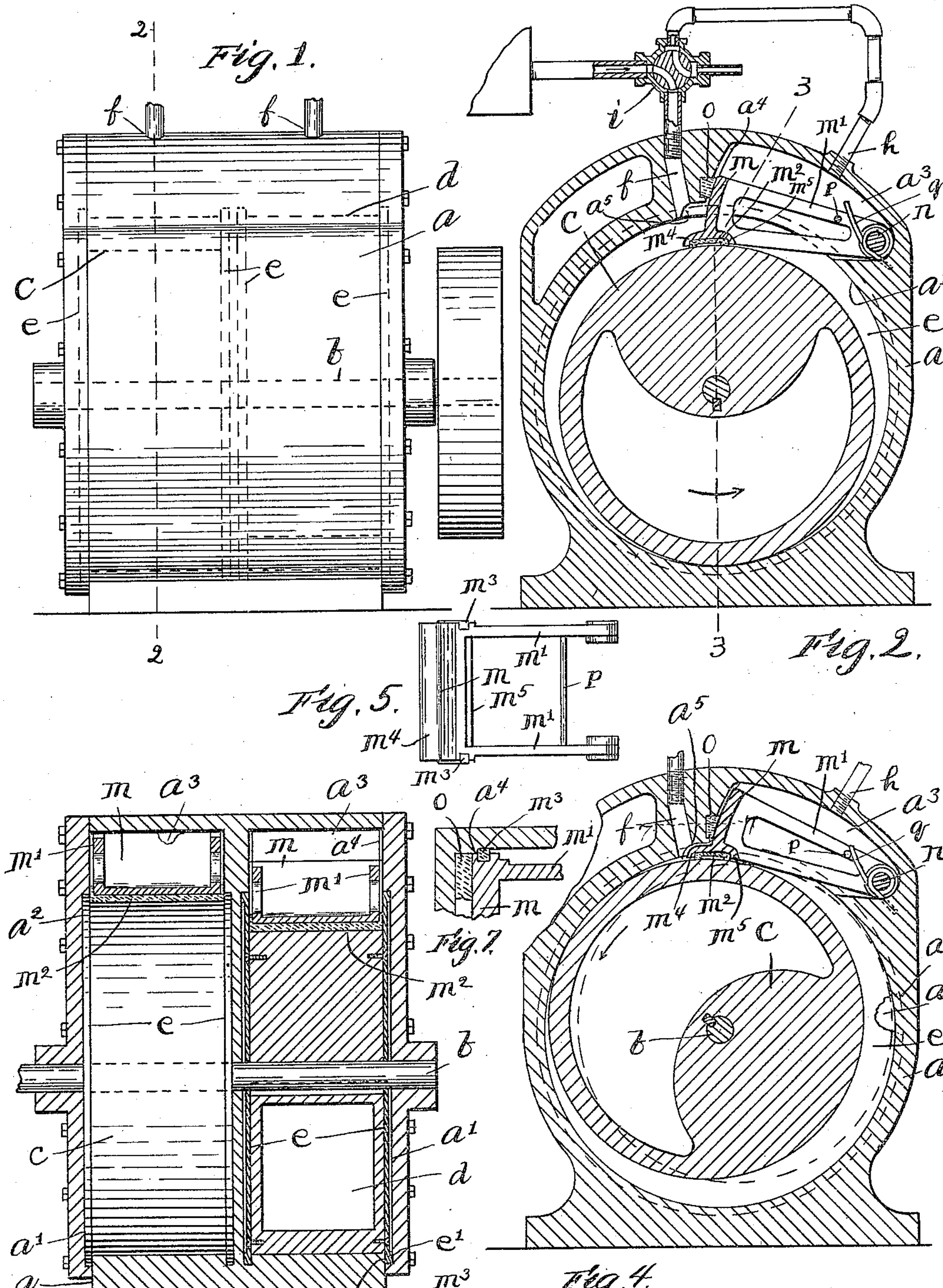
C. F. PAINE.

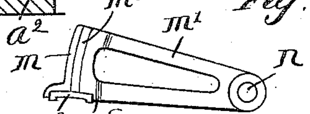
ROTARY ENGINE.

APPLICATION FILED JUNE 16, 1908.

934,830. Patented Sept. 21, 1909.

3 SHEETS—SHEET 1.





Witnesses:
H. B. Davis.
Cynthia Doyle.

Inventor:
Chas. F. Paine
by Noyes & Hamman
Attys

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

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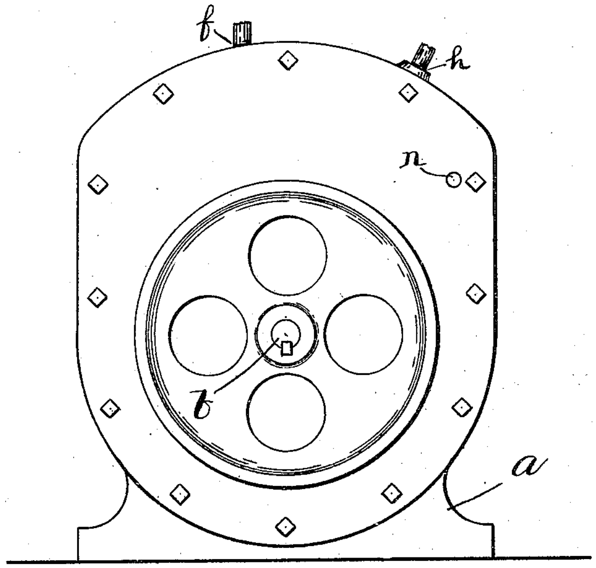

Fig. 8.

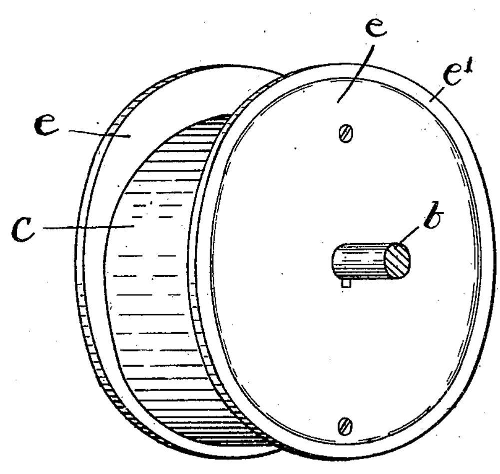

Fig. 9.

Witnesses:

H. B. Davis.

Cynthia Doyle.

Inventor:

Chas. F. Paine

by Boyce & Harriman

Attys

C. F. PAINE.

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3 SHEETS—SHEET 3.

Fig. 10.

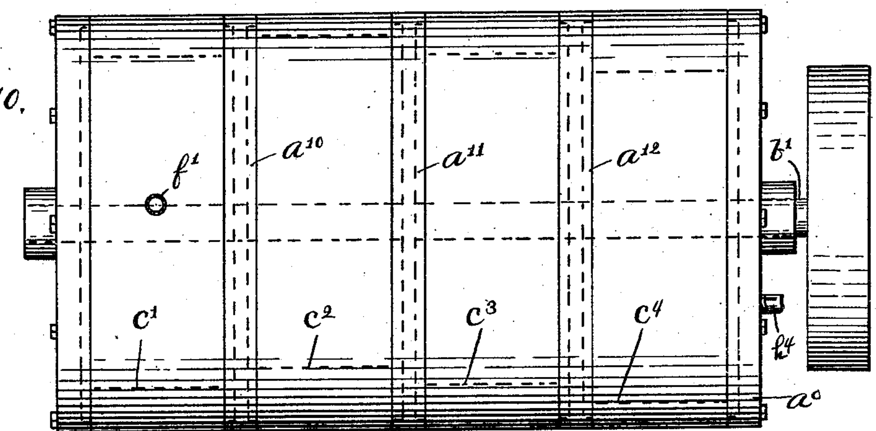


Fig. 11.

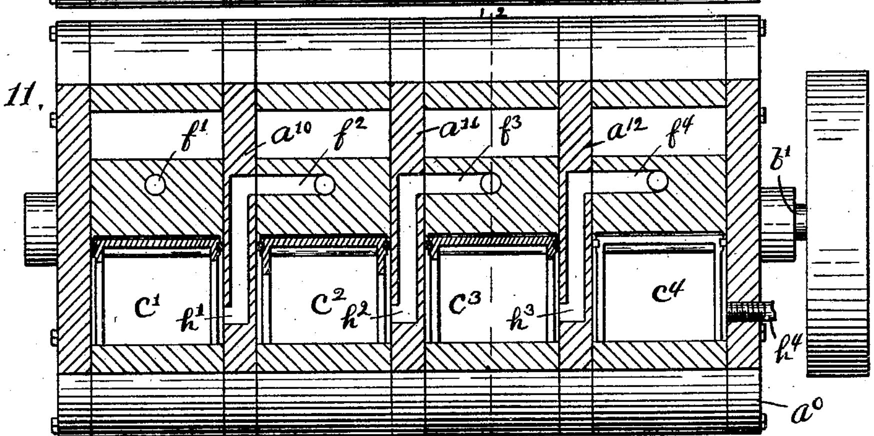
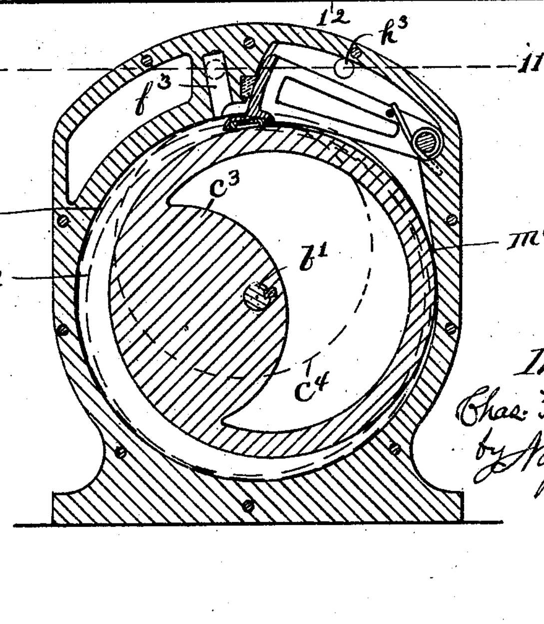


Fig. 12.



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Inventor:
Chas. F. Paine
by Poyrot Harriman
Att'ys

UNITED STATES PATENT OFFICE.

CHARLES F. PAINE, OF GROVELAND, MASSACHUSETTS.

ROTARY ENGINE.

934,830. Specification of Letters Patent. Patented Sept. 21, 1909.

Application filed June 16, 1908. Serial No. 438,713.

To all whom it may concern:

Be it known that I, Charles F. Paine, of Groveland, county of Essex, State of Massachusetts, have invented an Improvement in Rotary Engines, of which the following is a specification.

This invention relates to that class of elastic fluid engines in which a cylindrical piston is eccentrically mounted upon a rotary shaft adapted to rotate within a cylinder, a movable abutment being provided, which rides upon the piston and closes the communication between the inlet and exhaust chambers.

The objects of my invention are to provide a movable abutment and supporting means therefor, which will operate with a minimum loss of friction upon the piston, and the other surfaces with which it must contact in order to prevent the escape of steam from the inlet to the exhaust, without acting upon the piston, and particularly, which will be practically unaffected by the transverse thrust therein which tends to cause the same to be bound against its bearing surfaces, and further, to provide an effective means for reversing the outward movement of the abutment without causing undue friction on the piston during the outward movement, as when the reversal is entirely due to spring action, and to vary the frictional engagement of the abutment with the piston according to requirements.

Further objects are to provide means for preventing escape of steam about the sides of the piston, which will prevent undue wear and friction between the piston and the casing and to improve the device in certain other particulars to be hereinafter more fully explained.

I accomplish these objects by the means shown in the accompanying drawing, in which,

Figure 1 is a side elevation of an engine made according to my invention. Fig. 2 is a cross sectional view thereof on the line 2—2 of Fig. 1. Fig. 3 is a longitudinal section on the line 3—3 of Fig. 2. Fig. 4 is a section, similar to Fig. 2, showing the parts in a different position. Figs. 5 and 6 are detail, plan and side views of the abutment, Fig. 7 is an enlarged detail sectional view on the line 7—7 of Fig. 4. Fig. 8 is an end elevation of the same, and, Fig. 9 is a perspective view of one of the pistons. Fig. 10 is a side elevation of an engine showing a modification of my invention. Fig. 11 is a longitudinal section thereof on the line 11—11 of Fig. 12. Fig. 12 is a cross section on the line 12—12 of Fig. 11.

In the drawings a indicates the main casing of the device having two cylindrical chambers a' therein, and in which a shaft b is rotatably mounted centrally of said chambers. A pair of cylindrical pistons c and d are eccentrically mounted on said shaft and arranged preferably 180 degrees apart, to balance the shaft and avoid dead centers, so that the sides thereof most remote from the shaft b, will move in close engagement with the inner walls of their respective chambers, and internally tangent thereto, as in other devices of this general character. As the two pistons, and parts which coöperate therewith, are identical, said pistons, and their respectively associate parts, operate as two independent engines, so that a description of one, with its associated parts, will suffice.

Each piston is provided with a pair of circular disks e which are connected to each side thereof, the peripheries of said disks being concentric with the shaft b, extending a short distance beyond the piston at its longest radius with relation to the shaft, to form annular flanges, the casing, at each end of the inner cylindrical side walls of the piston chamber, being provided with annular recesses a^2 in which the edges of said disk e are fitted to rotate and to make as tight a connection as practicable between the ends of the piston and the end walls of the piston chamber. Said disks e are flat on their inner sides and slightly recessed on their opposite sides, to form axially extending annular ribs e', which engage the end walls of the casing, so that the only portions of said disks or flanges which are in frictional engagement with the casing are their peripheral edges and side-portions closely adjacent said edges. The frictional engagement between the piston and the casing is thus minimized, and a nearly steam tight engagement provided, the oil and water which will collect in said grooves a^2, tending to prevent the escape of steam past said flanges.

The portion of the piston which is the more remote from the shaft is chambered, so that it will not overbalance the opposite portion, said chamber being closed by the end disks, said disks in practice being secured in place after the piston has been perfectly balanced by chipping or boring.

The walls of the casing are extended at the upper side thereof to provide a gate receiving recess a^3, which leads directly from the piston chamber and is of the same width as the distance between the disks *e*, and so arranged that the corresponding inner surfaces of said disks and of said chambers a^3 are continuous and respectively lie in the same parallel planes.

The steam inlet port *f*, which is employed in the normal operation of the engine, is connected to the piston chamber closely adjacent one end of chamber a^3, and the exhaust port *h* is preferably connected to the upper side of chamber a^3, the pipes or passages connected to said ports being controlled by a four-way valve *i*, which may be turned to cut off the supply at such a point that the steam may be used expansively, and may be also turned so as to direct the steam supply into the exhaust port and the exhaust into the supply port, to reverse the engine.

An abutment plate *m* is mounted on a pivot *n* by means of parallel arms *m'*, rigidly connected to said plate, said pivot being mounted in the walls of the recess a^3 at the opposite side thereof from the supply port *f* and said plate being adapted to oscillate about said pivot as a center in close proximity to the opposite side of said recess from said pivot. Both sides of the plate are cylindrically curved about the axis of pivot *n* as a center, and the wall of the recess a^3, adjacent the convex side of the plate, is preferably correspondingly curved and is provided with a transverse packing *o*, which is seated therein closely adjacent the piston chamber and extends the entire width of said plate, the convex face of the plate being held in engagement with said packing to provide a tight joint therebetween and prevent the escape of steam in front of the plate. Said plate *m* is provided with a lower edge packing m^2, which is adapted to bear against the surface of the piston, to prevent the escape of steam therebeneath, and with packings m^3 in the side edges thereof, which are adapted to engage the inner sides of the piston disks *e* and the inner walls of the chamber a^3. As the packings m^3 project beyond the edges of the plate *m*, shoulders a^4 are provided in the side walls of chamber a^3, which engage the edge portions of plate *m* between packings m^3 and *o*, as shown in Fig. 7. The escape of steam past the abutment plate *m* directly from the supply to the exhaust is thus effectively prevented. The lower end of said plate *m* is provided with a transversely extending lip or foot m^4 which extends in front thereof at approximately right angles thereto and is adapted to support the packing m^2 at a distance in front of the convex face of plate *m*, upon the surface of the piston, said lip also preferably extending partially across the inlet port *f*, in the outermost position of said plate, and the casing *a* being provided with a recess a^5 into which said lip may move in the outermost position thereof. A lip m^5 similar to lip m^4, is also provided on the lower edge of plate *m* opposite the lip m^4 and projects beyond the concave side of the plate, the packing m^2 also being extended for a distance beneath said lip m^5, and preferably having its piston engaging face recessed beneath both lips.

A cross bar *p* is mounted in arms *m'* of the abutment plate, and a coiled spring *q* is mounted on the pivot *n*, one end of said spring being held by the casing and the other being disposed to engage said cross bar *p* during the latter portion of the outward movement of the plate, so as to arrest such movement gradually, and to react thereon at the end of the movement with sufficient force to reverse the movement practically instantaneously.

In operation the steam is admitted through the port *f* when the piston is, approximately, in the position of Fig. 4, in which the point of internal tangency between the piston and the casing will be just beyond or past the port *f*. At this point the motion of the abutment plate *m* will have been reversed by the spring *q*, the action of which is assisted by the entering steam, which will strike against the projecting lip m^4 of the gate, holding the same firmly against the surface of the piston. The steam pressure against the piston will cause the same to rotate, the action being the same as in other devices of this general character, and the steam supply is cut off at a suitable point and used expansively for the remainder of the rotation. As the piston rotates the abutment *m* will ride upon the piston, and will be held in engagement therewith by the steam pressure on the lip m^4, said abutment at all times closing communication between the exhaust and supply.

When the engine is operating at the best economy, the steam will be cut off at such a point that it will be fully expanded when the point of internal tangency of the piston reaches the entrance to the recess a^3, so that communication will then be opened to the exhaust port *h*, through the recess a^3, and past the supporting arms m' of the abutment. During the succeeding revolution the expanded steam will be exhausted through said recess a^3, as will be obvious.

To reverse the rotation of the engine, valve i is moved to admit steam through the exhaust port h and to exhaust it through the supply port f, it being necessary that the piston assume approximately the position indicated in dotted lines in Fig. 4, before the steam is admitted, and the operation being substantially the same as before described, the steam pressure on the lip m^5 acting to hold the gate in close contact with the surface of the piston, and the recess in the face of the packing m^2 enabling the pressure to be effectively applied.

By providing means on the abutment, which is directly acted upon by the steam in the cylinder, for holding the abutment in engagement with the surface of the piston, the force with which the gate is held against the piston will be varied according to the pressure in the piston actuating portion of the cylinder, so that such force will be varied according to requirements, that is, the greater the steam pressure the greater the frictional engagement necessary and vice versa.

By pivotally supporting the abutment plate, and curving its pressure receiving faces about its axis as a center, so that all the pressure thereon is radial and is, therefore, directly received by the pivot, the friction caused by said thrust is much less than it would be if the abutment were mounted to slide in ways, practically all tendency for the abutment to be bound during its in and out movements, by the steam pressure, being thereby eliminated, and the action in this particular being substantially the same at whichever side of the abutment the steam is admitted.

In Figs. 10, 11 and 12 I show an arrangement whereby the steam may be successively used in a series of piston chambers, and in which a^0 indicates a casing which is provided with a series of piston chambers separated by partition walls a^{10}, a^{11} and a^{12}. A series of pistons c', c^2, c^3 and c^4, of the form already described, are arranged on the central shaft b', the piston c' for the high pressure chamber being of the greatest diameter and the diameters of the other pistons being successively smaller and of correspondingly increased eccentricity, to permit the steam to be expanded to double its volume in each cylinder. A supply passage f' is provided, which leads to the chamber in which the piston c' is located and an exhaust passage h' leads therefrom. The other piston chambers are respectively provided with supply passages f^2, f^3 and f^4, and with exhaust passages h^2, h^3 and h^4, the exhaust passages h', h^2 and h^3 being respectively extended through the partition walls a^{10}, a^{11} and a^{12}, and respectively connected to the supply passages f^2, f^3 and f^4. The pistons are relatively arranged on the shaft so that the point of internal tangency of each piston is 90 degrees from the point of internal tangency of the next adjacent pistons and the exhaust chamber of each cylinder is so arranged that the point at which said chamber communicates with the piston chamber is approximately 90 degrees from the supply port thereof, so that, when the steam is admitted at the supply port f', the piston c' will rotate under pressure to the point indicated at m^0 in Fig. 12, at which point the steam will be permitted to escape to through the passage h' into the supply passage f^2. At the same instant the second piston c^2 will be in such position that its point of internal tangency will have just passed the port f^2, so that it will be in a position to receive the steam exhausted from the first chamber. The operation will be carried on successively to the other two chambers in like manner and finally delivered through the last discharge port h^4 as will be readily understood. With this arrangement the steam may be delivered directly from one piston chamber to the next through the separating walls, so that there will be no appreciable loss by condensation, as the steam is conveyed from one cylinder to the next.

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

1. An engine of the character described, comprising a casing having a piston-chamber and an abutment chamber leading therefrom, said chambers having ports leading thereto respectively, a rotary eccentric piston mounted in said chamber, and an abutment disposed to ride on the piston between the inlet and exhaust chambers of said piston and having a pair of supporting-arms respectively connected to the ends thereof, extending into said abutment chamber at opposite sides thereof and pivotally mounted at their inner ends in the casing, the port of said abutment chamber being located in the middle portion of the outer wall thereof, so that the free passage of steam from the piston chamber through the abutment chamber between said arms and its connected port is permitted, substantially as described.

2. An engine of the character described, comprising a cylinder having inlet and exhaust ports and having a rotary eccentric piston therein, an abutment disposed to ride upon the piston between the inlet and exhaust chambers of the cylinder and pivotally mounted at one side thereof in the cylinder casing, said cylinder having a bearing face disposed at the opposite side of the abutment from its pivot and said abutment

having a side face convexly curved about the center of the pivot thereof and arranged to engage said bearing face of the casing, a foot projecting from said abutment at the opposite side thereof from its pivot and adjacent its piston engaging edge, said foot being arranged to close a substantial portion of said inlet port when in its outermost position, so that it receives the impact of steam entering the inlet port, substantially as described.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

CHARLES F. PAINE.

Witnesses:

L. H. HARRIMAN,

H. B. DAVIS.