No. 719,222. PATENTED JAN. 27, 1903.

F. P. HUYCK.

BALANCED ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1901.

NO MODEL. 4 SHEETS—SHEET 1.

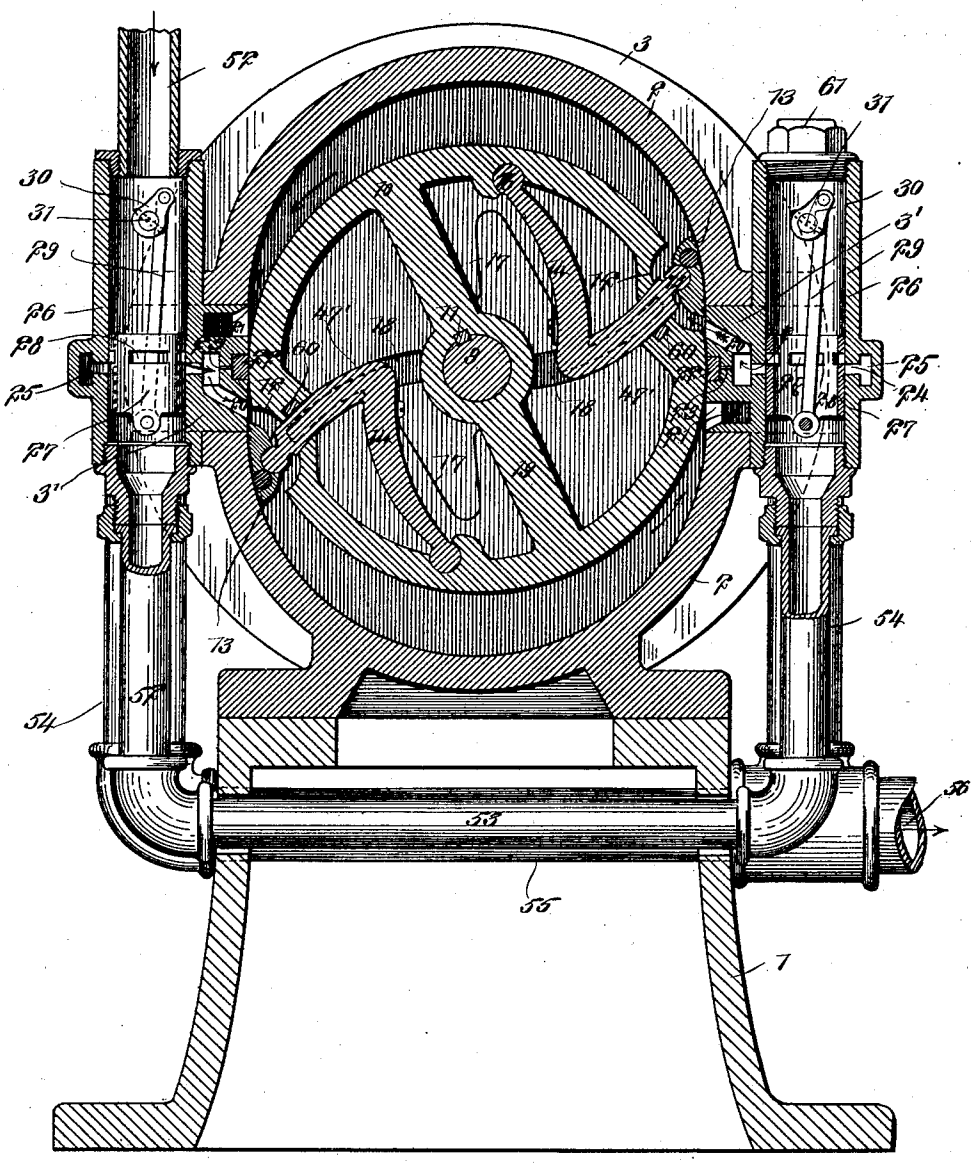


Fig. 1.

WITNESSES:

Paul Hunter

Walton Harrison

INVENTOR.

Francis P. Huyck

BY Munn & Co.

ATTORNEYS

No. 719,222. PATENTED JAN. 27, 1903.

F. P. HUYCK.

BALANCED ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1901.

NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2.

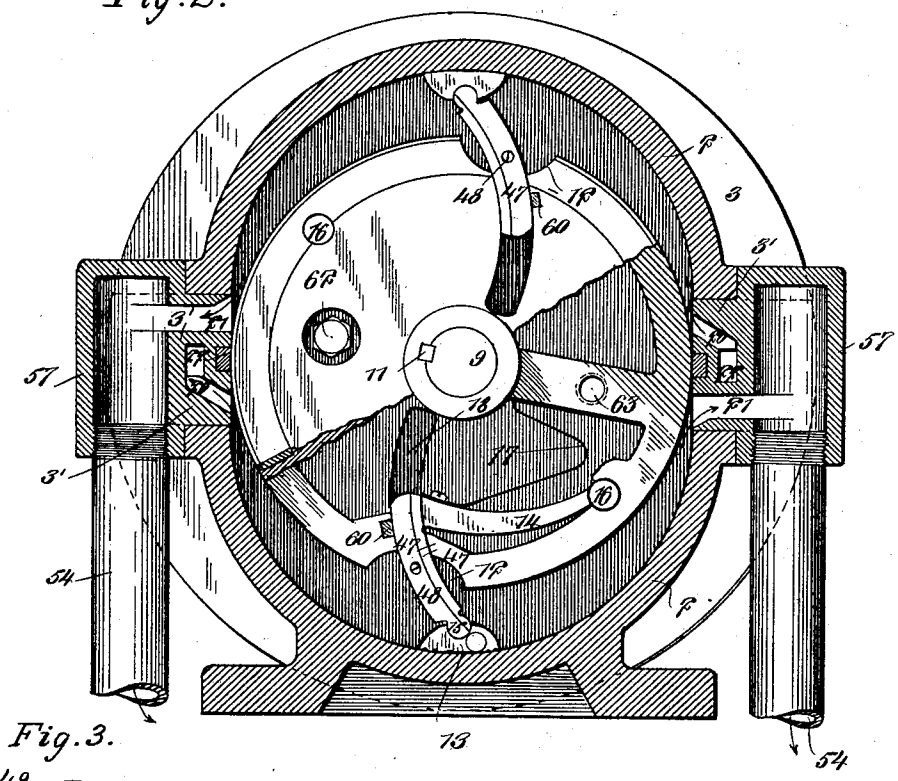


Fig. 3.

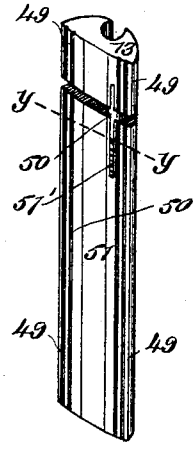


Fig. 4.

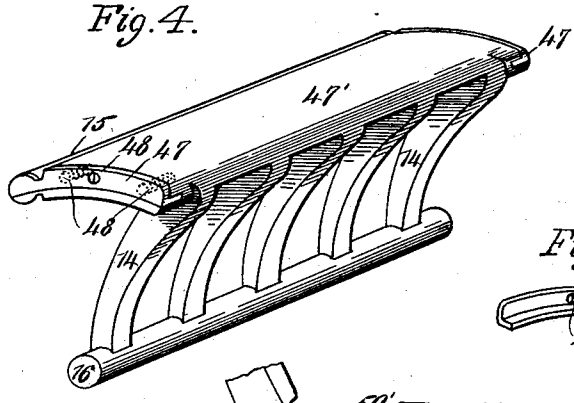


Fig. 5.

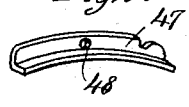
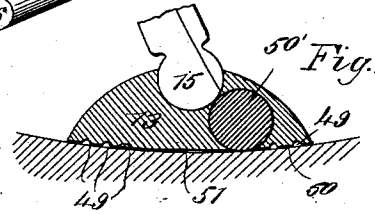


Fig. 11.



WITNESSES:

Paul Hunter

Walton Harrison.

INVENTOR.

Francis P. Huyck

BY Munn & Co.

ATTORNEYS

No. 719,222. PATENTED JAN. 27, 1903.

F. P. HUYCK.

BALANCED ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1901.

NO MODEL. 4 SHEETS—SHEET 3.

Fig. 6.

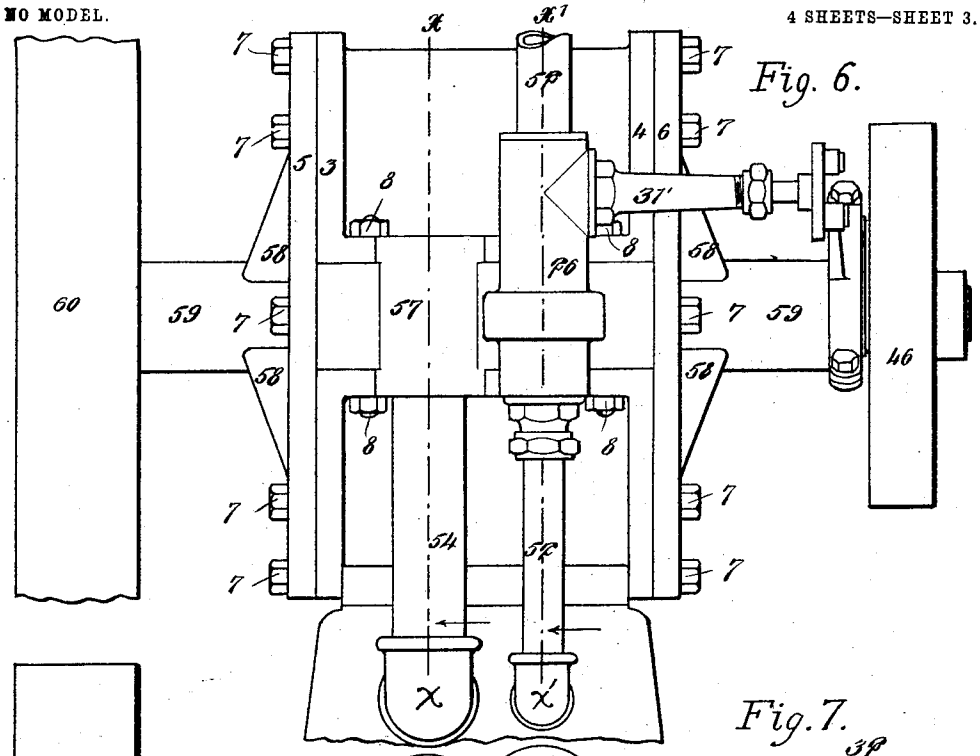
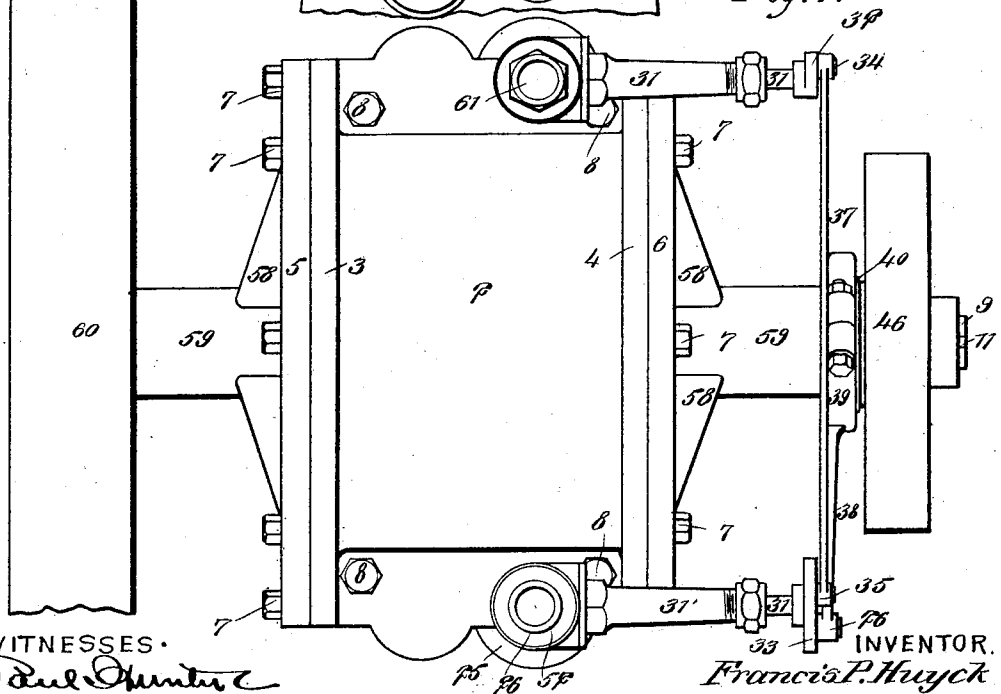


Fig. 7.



WITNESSES.

Paul Hunter C

Walton Harrison

INVENTOR.

Francis P. Huyck

BY Munn & Co

ATTORNEYS

No. 719,222. PATENTED JAN. 27, 1903.

F. P. HUYCK.

BALANCED ROTARY ENGINE.

APPLICATION FILED AUG. 15, 1901.

NO MODEL. 4 SHEETS—SHEET 4.

Fig. 8.

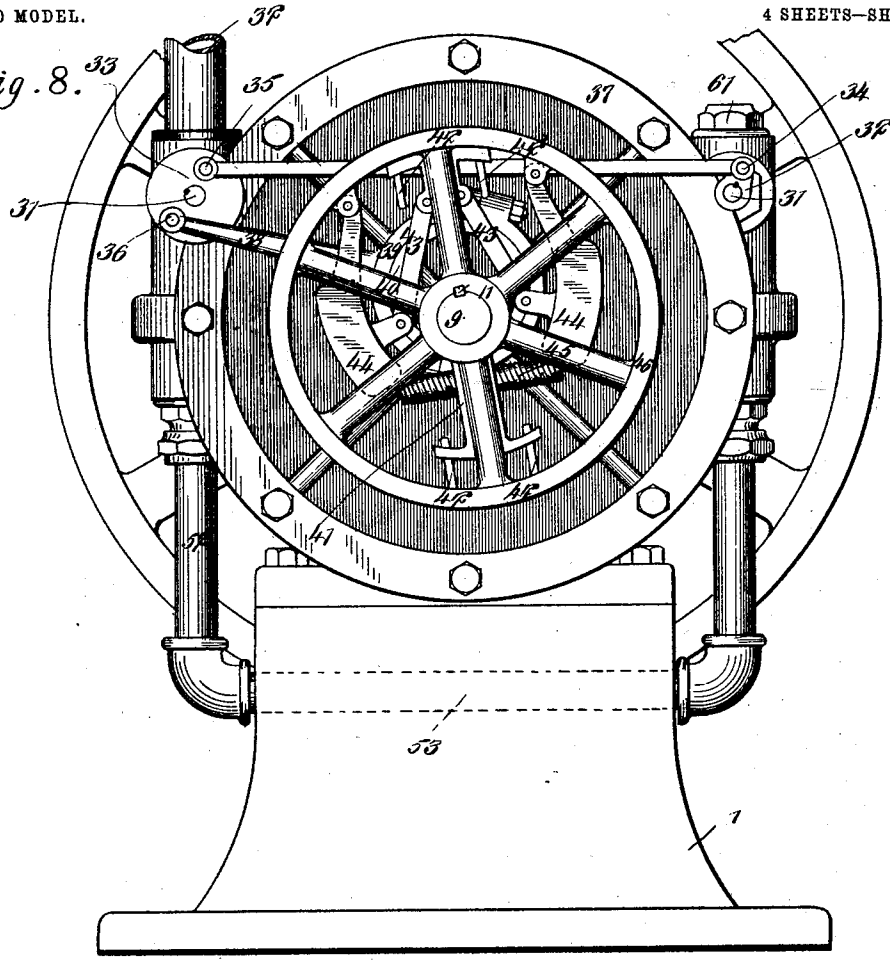


Fig. 9.

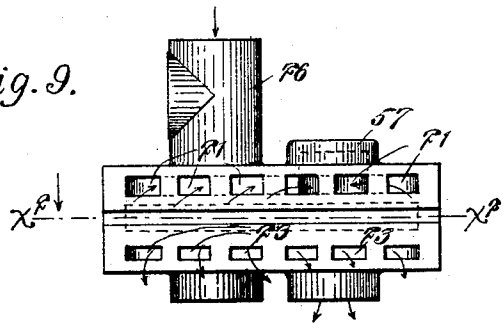
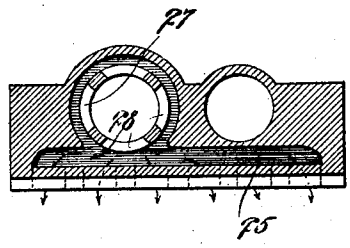


Fig. 10.



WITNESSES:

Paul Hunter

Walton Harrison

INVENTOR.

Francis P. Huyck

BY Munn & Co.

ATTORNEYS

UNITED STATES PATENT OFFICE.

FRANCIS P. HUYCK, OF SWANTON, OHIO, ASSIGNOR OF ONE-HALF TO JOHN D. R. LAMSON, OF TOLEDO, OHIO.

BALANCED ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 719,222, dated January 27, 1903.

Application filed August 15, 1901. Serial No. 72,128. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS P. HUYCK, a citizen of the United States, and a resident of Swanton, in the county of Fulton and State of Ohio, have invented a new and Improved Balanced Rotary Engine, of which the following is a full, clear, and exact description.

My invention relates to rotary engines, and the several objects of my improvements are to cause the moving parts to balance each other, to render the packing more efficient, to distribute the working strain more equally, and to provide a more efficient cut-off.

The invention consists of novel features and parts and combinations of the same, as will be fully described hereinafter and then pointed out in the claims.

A practical embodiment of the invention is represented in the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views.

Figure 1 is a vertical section on the line x' x' of Fig. 6 looking in the direction of the arrow. Fig. 2 is a section on the line $x\ x$ of Fig. 6 looking in the direction of the arrow. Fig. 3 is a detail showing the packing for rendering the movable parts steam-tight. Fig. 4 is a detail showing the piston or member which receives the steam-pressure proper. Fig. 5 is a detail showing the packings used at the ends of this piston. Fig. 6 is a side elevation of the engine. Fig. 7 is a plan of the engine. Fig. 8 is an elevation of the back side of the engine. Fig. 9 is a detail showing the steam-ports and their connections as viewed from the center of the engine. Fig. 10 is a section on the line line x^2 x^2 of Fig. 9 looking in the direction of the arrow. Fig. 11 is a section through the line $y\ y$ of Fig. 3.

The engine proper is mounted upon a frame 1. Two semicylindrical members 2 2 are moved asunder, and sandwiched between them are spacing-blocks 3', by means of which the parts taken together form an oval casing. Preferably the parts 2 2 are made in halves, so as to constitute a perfect cylinder which is bored in the usual manner, and the spacing-blocks 3' are afterward sandwiched between them. The semicylindrical parts terminate in flanges 3 and 4, to which are secured the casing-heads 5 and 6 by means of the bolts 7 in the usual manner. The bolts 8 pass vertically through holes made for the purpose, and thus connect the upper, middle, and lower parts of the casing together, making them practically integral.

9 is a rotary shaft which passes diametrically through the casing and is supported in appropriate journals 59. It carries the fly-wheel 60 and the governor-wheel 46. The rotary member 10 is secured upon the shaft 9 by means of the key 11 and is provided with longitudinal channels 12, which extend entirely across the cylinder. Normally resting in these channels 12 are two longitudinal shoes 13, which are mounted upon the universal joints 15 upon the pistons 47', which are in turn mounted upon the ribs or trusses 14, which are journaled at 16 in the revoluble member. By means of the spring 17 these pistons are thrown outward, so that the shoes 13 are pressed outward against the casing, so as to fit the same steam-tight. The centrifugal force used in the rotation of the rotary member also facilitates this action. The rotary member is provided with curved grooves or guideways 18, which have the general form of a mutilated cylinder, so that the curved pistons 47' fit into them precisely. When the pistons are rocked back and forth, so that the shoes 13 alternately move into the channels 12 and out against the casing, the pistons 47', notwithstanding their curvature, move smoothly in and out of the guideways 18. The rotary cylinder 10 is braced by means of integral spokes 19. The ports where the steam is admitted are shown at 20. The ports of exit are shown at 21. The packing 22 is flexible, but is normally inert. Live steam from the port 20 is admitted through the channel 23 to the rear of this packing, whereby the packing is forced into proximity with the rotary cylinder, thereby rendering the same steam-tight. It will be noticed that the steam is admitted above this packing on the right-hand side of Fig. 1 and below the packing on the left-hand side of this figure. At 24 are the apertures through which the steam is immediately admitted upon leaving the steam-chest 26. This steam-chest 26 is provided interiorly with an annular space 25.

(Shown more particularly in Figs. 1 and 10.) The cylindrical sliding valves 27 are provided with apertures 28, which at certain times during the stroke register with the apertures 24 in the steam-chest. The sliding valves are actuated by means of valve-stems 29, which are connected to the cranks 30, these cranks being mounted upon rocking shafts 31, so that the rocking of the shafts causes the reciprocation of the valves. At the back of the engine, as shown more particularly in Fig. 8, the rocking shafts 31 are provided with a crank 32 and a crank-disk 33, which are provided, respectively, with crank-pins 34 and 35. Upon the disk is another crank-pin 36. The crank-pins 34 and 35 are connected by means of a connecting-rod 37, and the crank-pin 36 is engaged by an eccentric-rod 38, terminating at the other end in an eccentric-strap 39, which is mounted upon the eccentric 40. This eccentric 40 is not secured rigidly to the rotary shaft 9, but is movable relatively to the same and is rigidly secured to the movable frame 41. This frame 41 slides upon guide-pins 42 and moves upon these pins, so as to carry with it within certain limits the eccentric 40. Pivoted to this frame 41 are two rods 43, which are likewise pivoted to the centrifugal weights 44, so that when these weights are thrown outward by centrifugal force the frame 41 is moved downward from its position shown in Fig. 8, its immediate travel being toward the center of the machine. As this frame is moved by the centrifugal force of the weights, the eccentric 40, being carried with it across the center of the shaft, is immediately changed relatively to the center shaft 9, and the throw of the eccentric-rod 38 is thereby shortened. As shown in Fig. 8, the eccentric-rod 38 has a maximum of throw; but when the weights 44 are thrown outward to the greatest extent the eccentric-rod 38 has the minimum of throw. The outer ends of the weights 44 are secured together by a spring 45, and upon the tension of this spring depends the speed of the engine, because the stronger the tension of the spring the greater the effort required to throw the weights asunder, and thereby change the throw of the valve by governing the arcs in which the crank-pins 35 36 rock.

Upon the ends of the piston 47′ are two packings 47, secured in position by screws 48, as shown more particularly in Figs. 4 and 5. These packings are for the purpose of rendering the piston steam-tight at the ends. The shoes 13 are provided with curved surfaces 50, which correspond with the curvature of the parts of the casing 23, and with flat surfaces 51, which correspond with the inner flat surfaces of the casing 3. Theses hoes 13 are made extensible, as shown in Fig. 3 and Fig. 11. This is done by separating each shoe into two members and coring each member so as to permit insertion of the plug 50′, which not only touches the joint 15, but grazes the edge of one of the surfaces 50. By this means the shoe 13 is rendered not only flexible in the direction of its length, but the joint is effectually rendered steam-tight by the plug. The spring 51′ is normally compressed when the shoe is in position, so as to force asunder the two members with a gentle pressure. The surfaces 50 are each provided with oil-grooves 49 for purposes of lubrication. Live steam is admitted through the pipe 52 and passes downward through one steam-chest and the pipe 53, then upward to the other steam-chest. The exhaust-ports 21 lead to the chambers 57 and then to the exhaust-pipes 54 55, which are connected to a larger exhaust-pipe 56. The braces 58 serve to make the casing stronger and to prevent undue strains. By releasing the bolt 61 access to the steam-chest is facilitated. By means of bolts 62, passing through holes 63, the several parts of the rotary member 10 are held together.

The operation of my device is as follows: Steam being admitted through the inlet-pipe 52 and passing through the valves enters the respective inlet-ports and engages the pistons, which, as above explained, are steam-tight. The stationary packings 22, actuated by steam, as above described, render the central rotary cylinder steam-tight, and when the steam encounters the pistons 47′ it of course drives the cylindrical rotary member around. The springs 17, together with the centrifugal force, cause the pistons 47′ to swing outward, so that the shoes 13 engage the casing steam-tight. The maximum steam-pressure is exerted upon the pistons when they occupy the respective top and bottom central portions of the casing, and of course there is no surface exposed to pressure of the steam when the pistons are at right angles with this position. The result is that as soon as the shoes 13 uncover the live-steam ports 20 the power gradually increases until it reaches a maximum and then gradually decreases until it reaches a minimum; but as the engine drives a light fly-wheel the motion is rendered substantially uniform. The dead-centers being short, a heavy fly-wheel of the kind used in reciprocating engines is not necessary.

It will be noticed that every movable part of the mechanism is thus balanced and that the centrifugal force pulling different parts asunder balances itself, and the steam-pressures affecting the movable parts also balance each other. The valves 27 perform the office of cut-offs for the purpose of utilizing the local expansive force of the steam. It will be noticed that as the eccentric 40 (shown in Fig. 8) is actuated by the weights 44, and the rocking shaft 31 is thereby given a different degree of play, the valves 27 have a different throw in consequence. The apertures 28 in the valve and the apertures 24 leading to the engine proper register with each other exactly under certain conditions; but as the play of the valves is controlled by the governor it is clear that the registry of the aper-

tures 28 and 24 varies with the speed of the engine. When the speed is very great and the eccentric 40 is substantially concentric with the shaft 9, so that the rocking shafts 31 have little play, it is clear that little steam will be admitted and that the engine must slow up. Vice versa, when the governor is in the position shown in Fig. 8 the cut-off valves have a maximum of throw and the apertures are made to register exactly twice during each stroke, so that a maximum quantity of steam is admitted and the engine must therefore quicken its pace. It will be observed, therefore, that this particular type of governor has a peculiar relation to cut-off valves such as no other governor would have.

The piston is one of the prominent features of my invention. The web 47′ is cored out for the purpose of making it light, and the ribs or trusses 14 are built in a form calculated to secure a maximum of stiffness and strength and a minimum of weight.

The rocking shaft 16 is provided with a long wearing-surface to insure durability.

It will be observed that my valve-gear is one of unusual efficiency. By its use the ports are opened precisely at the same time, admitting steam against the pistons while exactly in the same position regardless of the length of time the valves remain open. This is done by the control of the governor. In some other forms of gear the time of opening ports is changed when the closing time is changed. The effect of this is to make the opening too early or too late against the pistons as they pass the ports. To thus make the ports both open at exactly the same time, as in my construction, regardless of the length of time the valves remain open is an important feature.

By virtue of the balancing effect above mentioned not only does the centrifugal force neutralize itself, but the engine is so arranged that any tendency to displacement of any part by steam-pressure is exactly met by a contrary steam-pressure, so that in all respects the engine balances itself exactly.

It may sometimes be advisable to use live steam, especially in the larger machines, instead of the springs above described. When this is the case, I simply run a small pipe provided with a cock from the supply-pipe at a point above the throttle-valve to one of the cylinder-heads, near the hub thereof. By this means both in starting and in stopping I allow live steam to enter the piston-hub independently of the throttle-valve to throw the pistons outward and into contact with the oval casing. Of course after starting I shut off this independent supply of steam as soon as centrifugal force acts upon the pistons so as to keep them thrown outward.

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

1. In a rotary engine, the combination of a revoluble member provided with radial guideways each terminating at its outer end in an enlarged transverse groove, a casing, swinging piston members pivoted in said revoluble member and having pressure-sections arranged to travel in said guideways and project through said grooves, and shoes loosely connected to said pressure-sections and arranged to be received within said grooves and to lie flush with the revoluble member on the retraction of the swinging piston members.

2. In a rotary engine, the combination of a revoluble member having external transverse grooves in its exposed surface, and a series of curved guideways lying in generally radial directions and intersecting with said grooves, said grooves being wider than the guideways, swinging piston members pivoted in said revoluble member at points concentric with said guideways and having pressure-sections arranged to travel in said guideways, and shoes loosely connected to said pressure members and arranged to be received in said grooves, each shoe being extensible.

3. In a rotary engine, a skeletonized piston member cast in a single piece and comprising a pivotal shaft or rod, a solid or imperforate pressure-section disposed longitudinally to said shaft or rod and at a distance therefrom, and a series of spaced arms arranged at an angle to the pressure-section and integral with said shaft and the pressure-section, in combination with a casing, and a revoluble piston member adapted to carry a series of said swinging members.

4. In a rotary engine, a swinging piston member having a solid pressure-section joined by a series of angularly-disposed arms to a pivotal rod or shaft, an extensible shoe at the exposed edge of the pressure-section, and packings fitted to the end portions of said solid pressure-section, combined with a casing, and a revoluble member arranged to carry a series of said swinging members.

5. In a rotary engine, an extensible piston-shoe comprising members arranged endwise to each other, and a cylindrical plug coupling said members together and arranged to open through the active surface of the shoe, combined with a casing, a revoluble piston member, and movable piston members each arranged to carry one of said piston-shoes.

6. In a rotary engine, an extensible piston-shoe comprising members arranged in opposing endwise relation and provided with a curved active face, and a plug socketed in the opposing ends of said shoe members and coupling them together, combined with a casing, a revoluble piston member, and movable piston members each arranged to carry one of said piston-shoes.

7. In a rotary engine, an extensible piston-shoe comprising members coupled together for endwise movement, each shoe member having its active face formed with a flat portion between curved side portions thereof, and said curved portions of the shoe-face provided with lubricating-channels, combined with a casing, a revoluble piston member,

abutments arranged for the flat face of each piston-shoe to traverse the same, and swinging piston members each having pivotal connection with one piston-shoe.

8. In a rotary engine, a valve-chest having a surrounding annular live-steam space in communication with the valve-chamber of said chest, a series of inlet-ports supplied with steam from the annular space, the exhaust-ports, a packing-space which is disposed between the two series of respective inlet and exhaust ports, packings in said space and arranged to be exposed within the piston-chamber, and a valve operable in the valve-chamber of said chest, combined with a piston-casing, and a revoluble piston therein.

9. A rotary engine having a casing, an engine-shaft, a revoluble piston therein, vertical valve-chests disposed on opposite sides of the axis of rotation of said piston and each having connections with a common source of live-steam supply and adapted to maintain equal pressures in said chests, the exhaust and live steam ports to said piston-casing, valve-shafts mounted transversely in said chests, tubular valves fitted slidably in the chests and provided with ports arranged to simultaneously register with said inlet-ports of the chests and having operative connection with the shafts to be given equal travel thereby, means connecting said valve-shafts, and a governor on the engine-shaft and connected with one valve-shaft.

10. A rotary engine comprising a cylinder, a revoluble piston therein, valve-chests disposed on opposite sides of the cylinder and each having inlet and exhaust ports in communication with the cylinder, said ports being separated by intervening abutments normally engaged by said piston, cylindrical valves reciprocable in the valve-chests to cut off the supply to the inlet-ports and each having ports arranged to supply live motive fluid to the inlet-ports, a governor, and crank connections actuated by the governor and connected with said cylindrical valves; said crank connections imparting motion to the valves to positively open the inlet-ports at fixed periods and to close the ports at variable periods.

11. A rotary engine comprising a cylinder, a revoluble piston therein, valve-chests on opposite sides of the cylinder and each having a series of inlet-ports and a series of exhaust-ports, the ports of the two series being separated by an intermediate abutment and each chest being also provided with a surrounding channel which communicates with the inlet-ports only, hollow cylindrical valves slidable in the chests and each having ports arranged at one period of the valve to register with the surrounding channel of the chest, crank-shafts linked to said valves, and a governor having crank connections with said shafts; the shafts serving to simultaneously actuate said valves for opening the ports at fixed intervals and to close the ports at variable intervals.

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

FRANCIS P. HUYCK.

Witnesses:
FRED. E. PILLIOD,
DAVID HUYCK.