No. 781,342. PATENTED JAN. 31, 1905.

W. M. HOFFMAN.

ROTARY ENGINE.

APPLICATION FILED APR. 4, 1904.

Fig. 1.

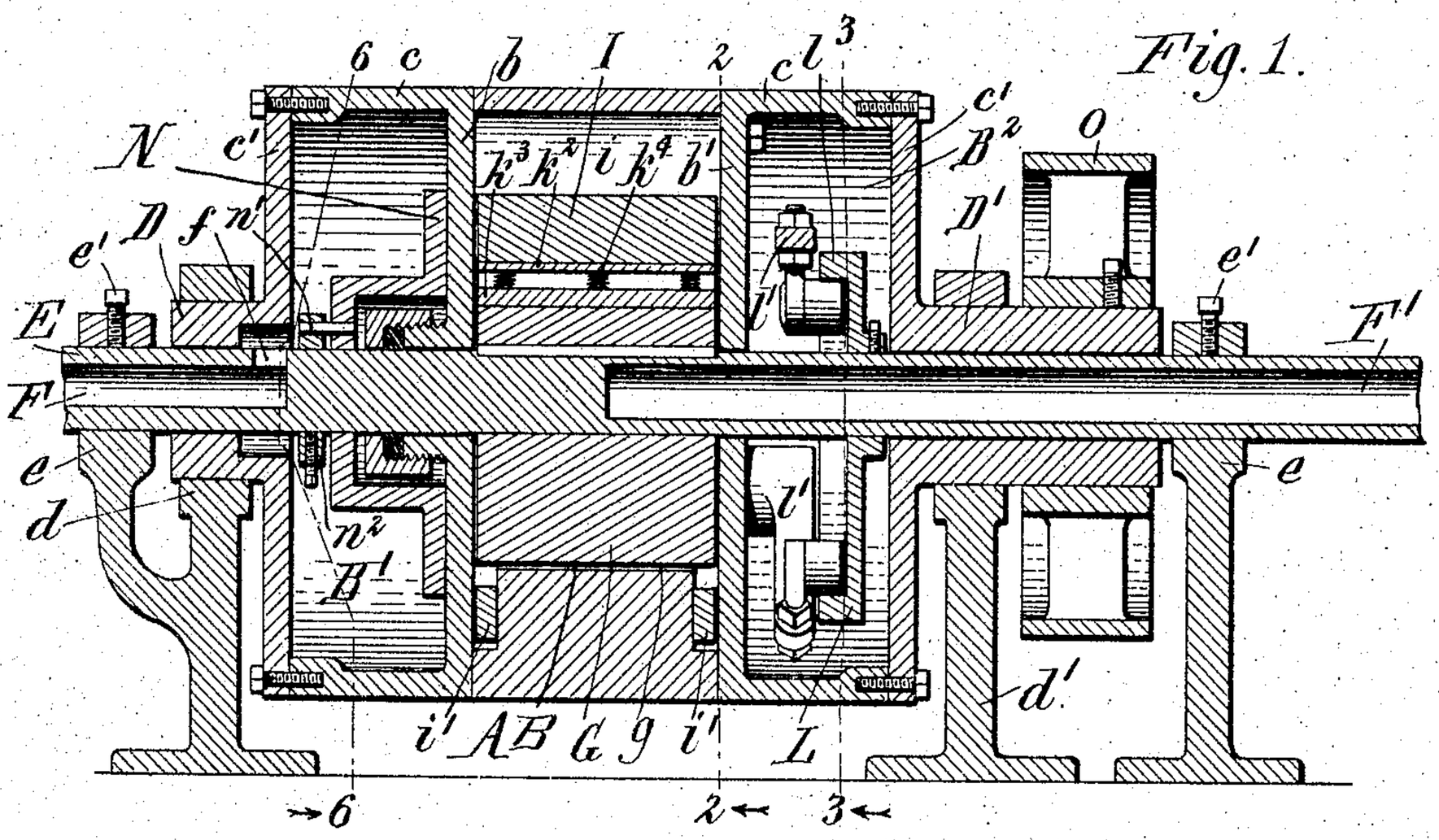


Fig. 2.

Fig. 3.

Fig. 4.

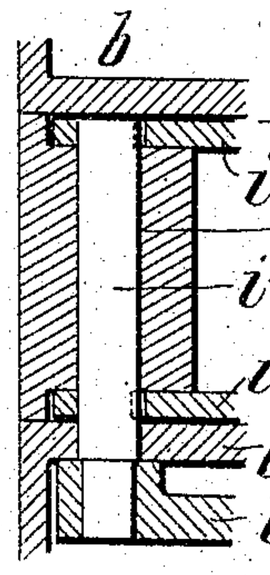


Fig. 5.

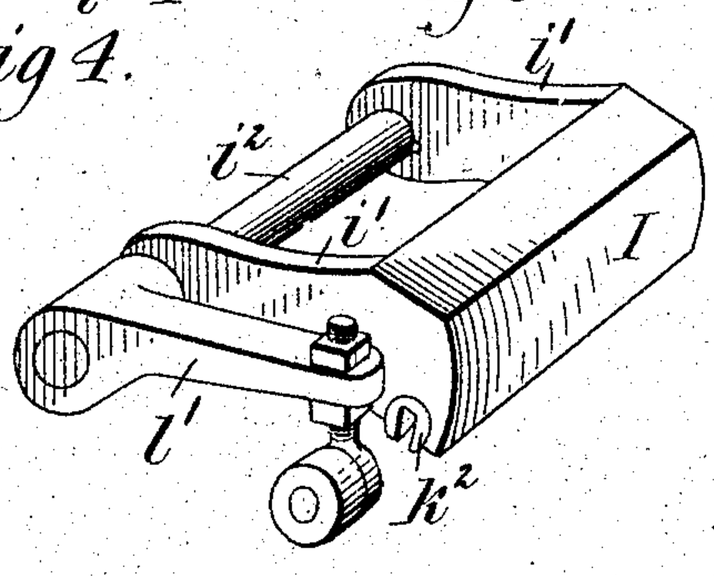
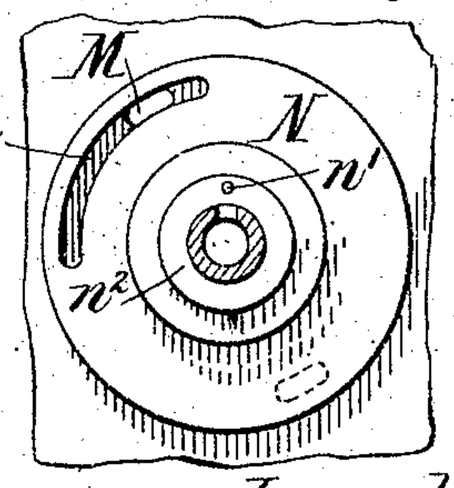


Fig. 6.



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No. 781,342. Patented January 31, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM M. HOFFMAN, OF BUFFALO, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL ENGINE COMPANY, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 781,342, dated January 31, 1905.

Application filed April 4, 1904. Serial No. 201,397.

To all whom it may concern:

Be it known that I, WILLIAM M. HOFFMAN, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates more particularly to rotary engines of that kind having a casing or cylinder which is journaled to rotate and is driven by the pressure of steam or other motive fluid against movable pistons carried by the casing and held in sliding contact with the periphery of a core or body arranged eccentrically in the rotary cylinder.

The primary object of the invention is to provide an efficient economical rotary engine of simple, durable, and compact construction in which clearance, friction, and wear are reduced to the minimum.

Another object of the invention is to improve the construction of the engine in certain particulars, which will appear from the following description and claims.

In the accompanying drawings, Figure 1 is a longitudinal sectional elevation of a rotary engine embodying the invention. Fig. 2 is a sectional elevation thereof in line 2 2, Fig. 1. Fig. 3 is a sectional elevation thereof in line 3 3, Fig. 1. Fig. 4 is a detail section of one of the piston-pivots and its bearing. Fig. 5 is a perspective view of one of the piston-blades and its operating-arm detached. Fig. 6 is a sectional elevation in line 6 6, Fig. 1, showing the cut-off valve.

Like letters of reference refer to like parts in the several figures.

The rotary casing or cylinder A comprises a cylindrical concentric piston-chamber B, located between its ends, and chambers B′ B², arranged at opposite ends of the piston-chamber, from which they are separated by walls or partitions *b b′*. One of these chambers—for instance, the chamber B′—constitutes a valve chest or chamber and the other an inclosing chamber for the operating mechanism for the pistons. In the construction shown in the drawings the chambers B′ B² are formed by hollow cylindrical shells *c*, which are bolted to opposite ends of the middle cylindrical body portion of the cylinder, and have removable heads *c′*, bolted or otherwise secured to and closing the open ends of the shells *c*.

The cylinder is mounted in any suitable manner to rotate about its central axis, for which purpose the heads *c′* are preferably provided with projecting journals D D′, which bear and turn in bearings *d d′*, respectively, of any ordinary form.

E represents a stationary shaft which passes centrally through the cylinder and its journals and preferably seated at its ends in bearings *e*, in which it is held against rotation by set-screws *e′* or other means. The opposite ends of the shaft are preferably hollow, forming supply and exhaust passages F F′, respectively, for the steam or other motive fluid. The supply-passage F connects with the valve-chamber by a port *f* in the shaft, and the piston-chamber connects with the valve-chamber and exhaust-passage, as hereinafter explained.

G represents a stationary core or body arranged eccentrically in the piston-chamber and extending from end to end thereof. It is keyed to the stationary shaft E, or it may be fixed to the shaft or held stationary in any other convenient way. The core is preferably of substantially elliptical cross-section, as shown in Fig. 2, the long sides of its periphery from end to end being of substantially the same curvature and one long side *g* being concentric with and in close proximity to the inner cylindrical wall of the piston-chamber for substantially the full length of said side. The long side should be as close to the cylindrical face of the piston-chamber as practical without being in actual frictional contact, so as to reduce the clearance between the core and cylinder as much as possible and for the greatest possible length of the core. The ends of the elliptical core are curved on as short a radius as is consistent with the smooth running of the pistons, which slide on its periphery. One long side of the periphery of the core is thus concentric with and in close proximity

to the cylindrical wall of the piston-chamber, and there is virtually no clearance between the two for substantially half of the circumference of the piston-chamber, while the opposing long side of the core from the opposite ends thereof rapidly recedes from the cylindrical wall of the piston-chamber.

H represents an exhaust port or passage in the core leading from one end thereof and connecting with the exhaust-passage F′ in the stationary shaft.

I represents pistons, wings, or blades which are carried by and extend lengthwise of the cylinder and are movable in and out in pockets i in the latter in lines substantially radially of the cylinder and substantially at right angles to the direction of fluid-pressure on the pistons. The pistons bear at their inner edges against and slide on the periphery of the stationary core in the rotation of the cylinder and are connected, preferably by arms i', at their ends with pivots or pins i^2, which bear and rock in longitudinal holes i^3, Fig. 4, in the cylinder. The pistons and their pockets are curved concentrically with the pivots, and the pistons are held by their arms out of contact with the curved walls of their pockets, so that they cannot be forced against said walls by the pressure of the motive fluid thereon, thus relieving these parts from friction. The pressure of the motive fluid is exerted on the pistons substantially in a line passing centrally through their impact-faces and pivots, so that practically the entire pressure is carried by the pivots, and the fluid exerts very little if any pressure on the pistons in a direction to press them in against the core. The friction and wear between the pistons and core is thus reduced to the minimum. Motive fluid is prevented from entering the piston-pockets by sliding packing-bars k, confined in recesses in the curved rear walls of the piston-pockets and pressed yieldingly against the adjacent or rear curved faces of the pistons by suitable springs k'. Each piston is preferably provided at ts inner edge with a segmental cylindrical socket in which is confined and capable of oscillating a cylindrical block or shoe k^2, having a longitudinal recess containing a sliding packing-bar k^3, which is pressed yieldingly against the periphery of the stationary core by suitable springs k^4.

The pistons are positively moved and caused to follow the contour of the periphery of the stationary core and are held in sliding contact therewith without undue pressure and friction by the following means: A stationary cam L is fixed on the stationary shaft E in the chamber B^2 of the cylinder and has a cam flange or rim l, conforming in shape to the periphery of the stationary core, and arms l' are fixed to the ends of the piston-pivots, which project into the chamber B^2 at their free ends and are provided with rollers which travel on said cam-flange. As the rollers travel in a path similar to the periphery of the core, the pistons are prevented from moving out of contact with the core.

M represents inlet-ports for the steam or other motive fluid, located one adjacent to the rear side of each piston and connecting the piston and valve chambers, being preferably formed in the wall or partition b, separating said chambers. These inlet-ports are controlled by a cut-off valve N, located in the valve-chamber against the partition b and provided with a port n, with which the inlet-ports M alternately register in the rotation of the cylinder. The cut-off valve is mounted on the stationary shaft E and is held from rotation by a pin n', secured to a fixed collar n^2 on the shaft entering a hole in the valve. This connection allows the valve to slide longitudinally on the shaft and to be pressed by the motive fluid against the partition b to effect a fluid-tight joint. Any other suitable valve may be employed.

A drive pulley or wheel O is secured to one of the journals of the cylinder, or the cylinder itself can constitute a drive-pulley.

In operation steam or other motive fluid is admitted to the piston-chamber in rear of one of the pistons I through one of the inlet-ports M, connecting the piston-chamber and valve-chest, when said inlet-port registers with the port n in the stationary cut-off valve N and exerts its pressure against said piston, causing the latter and the cylinder, to which it is connected, to turn, for example, to the left, as indicated by the arrow in Fig. 2. The motive fluid is cut off when the inlet-port moves past the port n in the cut-off valve and operates expansively against the piston until the latter passes and uncovers the exhaust-port H in the core and permits the discharge of the motive fluid through the exhaust-passage F′ in the stationary shaft. The motive fluid thus acts upon the pistons alternately.

The relative arrangement of the pistons and core and the shape of the latter, as before described, is such that when the motive fluid is exerting its pressure on one piston to turn the engine forwardly the other piston bears against the side g of the elliptical or cam-shaped core which is concentric with and in close proximity to the cylindrical face of the piston-chamber, so that there is little or no portion of this piston exposed to the back pressure of the motive fluid. The piston bearing against the side g of the core also serves to pack or close the space between the cylinder and core, and it is not necessary to provide the core with a packing having a sliding contact with the cylindrical face of the piston-chamber. This is a great advantage, especially in large engines, where the speed of this face of the cylinder is very great. A further advantage of the described shape of the core is that the area of the piston exposed to the motive fluid increases much more rapidly after

the piston passes the end of the elliptical core than it would if the core were of cylindrical form, and owing to the fact that the engine commences to take steam or motive fluid just after the piston passes the end of the core there is very little clearance between the cylinder and core in rear of the piston. As the pistons are held by their arms out of contact with the walls of their pockets, there is no friction between these parts, and the friction occurs on the pivots of the pistons, which can be readily replaced at small cost, and as the pistons bear on the core at a considerable distance from their pivots the leverage is such as to make the engine very light-running.

Packing may be employed where necessary between the piston-arms and cylinder and between the ends of the core and piston-chamber and elsewhere; but it is not necessary to an understanding of this invention to show and describe such packing.

The engine described is also well adapted for use as a compressor for air and gas and as a liquid-pump.

I claim as my invention—

1. In a rotary engine, the combination of a rotary cylinder, a stationary core arranged eccentrically therein, a piston pivoted to said cylinder and having an impact-receiving face which bridges the space between the cylinder and the core and is disposed substantially perpendicular to a line passing centrally through said face and through the pivotal center of the piston, whereby the fluid-pressure is exerted on said face in a direction substantially parallel with such line, a rocking shoe carried by said piston and bearing against the periphery of said core, and mechanism for positively holding said shoe against the periphery of said core, substantially as set forth.

2. In a rotary engine, the combination of a rotary cylinder, a stationary core arranged eccentrically therein, a piston pivoted to said cylinder and having an impact-receiving face which bridges the space between the cylinder and the core and is disposed substantially perpendicular to a line passing centrally through said face and through the pivotal center of the piston, whereby the fluid-pressure is exerted on said face in a direction substantially parallel with such line, a rocking shoe carried by said piston and bearing against the periphery of said core, a cam, and connections between said cam and piston for positively holding said shoe against the periphery of said core, substantially as set forth.

3. In a rotary engine, the combination of a rotary cylinder, a stationary core of elliptical shape in cross-section arranged eccentrically in the cylinder with one of its long sides concentric with and in close proximity to the inner face of the cylinder, and a piston pivoted to said cylinder and having an impact-receiving face which bridges the space between the cylinder and the core and is disposed substantially perpendicular to a line passing centrally through said face and through the pivotal center of the piston, whereby the fluid-pressure is exerted on said face in a direction substantially parallel with such line, a rocking shoe carried by said piston and held against the periphery of said core, and means for admitting and exhausting motive fluid to and from said cylinder, substantially as set forth.

4. The combination of a rotary cylinder, a stationary core of substantially elliptical cross-section arranged eccentrically in said cylinder with one of its long sides concentric with and in close proximity to the inner face of said cylinder for substantially the full length of said side, two pistons movably mounted in said cylinder at diametrically opposite sides thereof and bearing against the periphery of said core, and means for admitting and exhausting fluid to and from said cylinder adjacent to the ends of said elliptical core, substantially as set forth.

5. The combination of a rotary cylinder, a stationary core of substantially elliptical cross-section arranged eccentrically in said cylinder with one of its long sides concentric with and in close proximity to the inner face of said cylinder for substantially the full length of said side, two pistons movably mounted in said cylinder at diametrically opposite sides thereof and bearing against the periphery of said core, fluid-exhaust ports at one end of said elliptical core, and a cut-off valve and port for admitting fluid to said cylinder at the times when said pistons pass the other end of said elliptical core, substantially as set forth.

6. The combination of a rotary cylinder, a stationary core of substantially elliptical cross-section arranged eccentrically in said cylinder with one of its long sides concentric with and in close proximity to the inner face of said cylinder for substantially the full length of said side, pistons movably mounted in said cylinder at opposite sides thereof and bearing against the periphery of said core, fluid-inlet ports in said cylinder adjacent to said pistons, a cut-off valve controlling said inlet-ports, and an exhaust-port in said core, substantially as set forth.

Witness my hand this 1st day of April, 1904.

WILLIAM M. HOFFMAN.

Witnesses:

C. M. BENTLEY,

E. C. HARD.