(No Model.) 2 Sheets—Sheet 1.

C. W. & E. B. DAKE.

RECIPROCATING ROTARY ENGINE.

No. 476,369. Patented June 7, 1892.

Fig. 1.

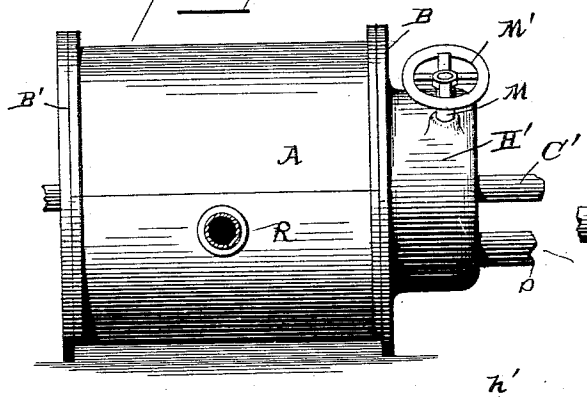


Fig. 2.

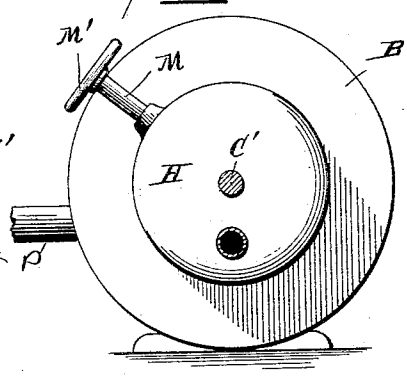


Fig. 3.

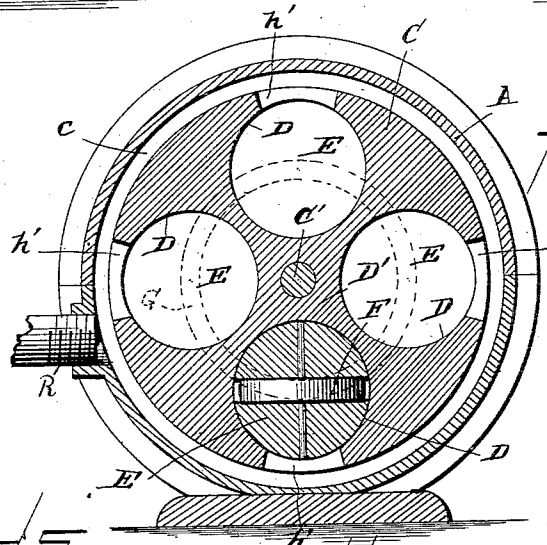


Fig. 5.

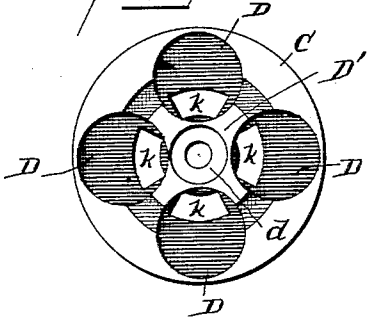


Fig. 6.

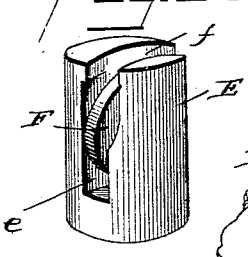
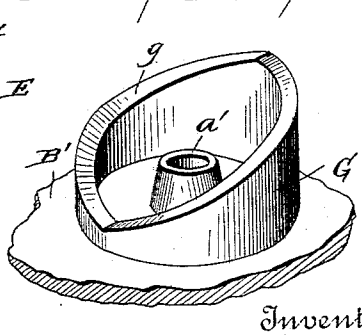


Fig. 7.



Witnesses
Samuel Ker.
Philip Lessmann.

Inventors
Chas. W. Dake
E. B. Dake
by E. W. Andersen
their Attorney

(No Model.) 2 Sheets—Sheet 2.

C. W. & E. B. DAKE.

RECIPROCATING ROTARY ENGINE.

No. 476,369. Patented June 7, 1892.

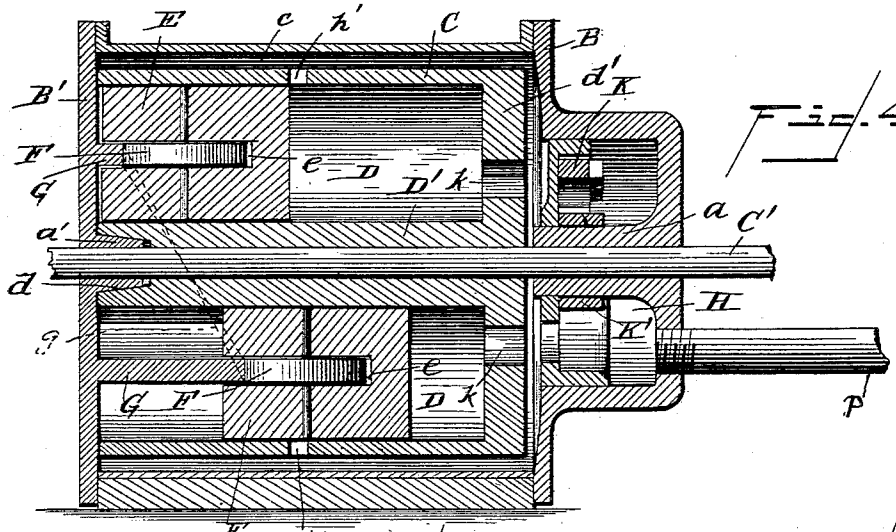


Fig. 4.

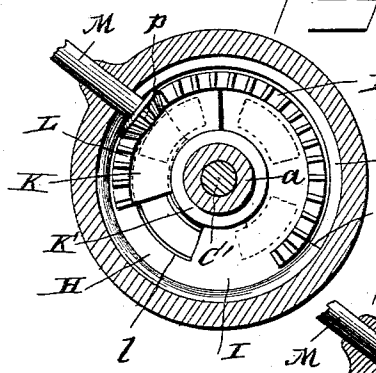


Fig. 8.

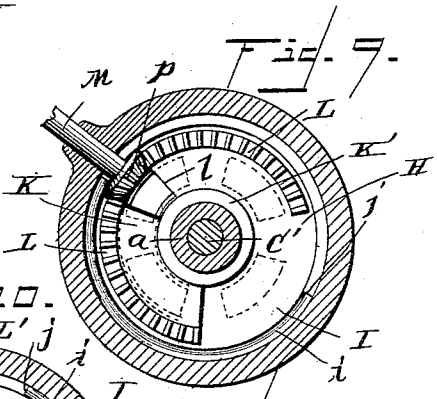


Fig. 9.

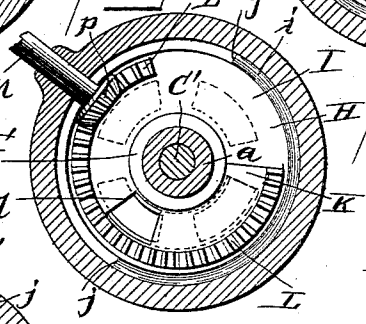


Fig. 10.

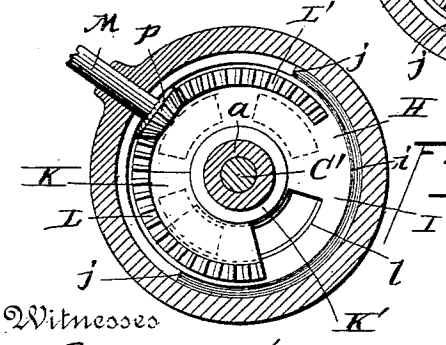


Fig. 11.

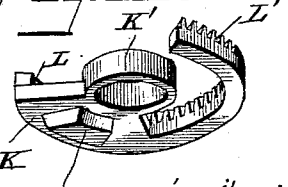


Fig. 12.

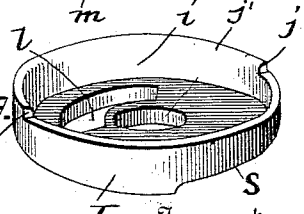


Fig. 13.

Witnesses
Samuel Ker.
Philip Lemasi.

Inventors
Chas. W. Dake
E. B. Dake
by E. W. Anderson
their Attorney

UNITED STATES PATENT OFFICE.

CHARLES W. DAKE, OF GRAND HAVEN, AND EDWARD B. DAKE, OF MUSKEGON, MICHIGAN.

RECIPROCATING ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 476,369, dated June 7, 1892.

Application filed August 28, 1891. Serial No. 403,990. (No model.)

To all whom it may concern:

Be it known that we, CHARLES W. DAKE, a resident of Grand Haven, county of Ottawa, and EDWARD B. DAKE, a resident of Muskegon, in the county of Muskegon, State of Michigan, citizens of the United States, have invented certain new and useful Improvements in Reciprocating Rotary 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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

Figure 1 is a side elevation. Fig. 2 is a front end view. Fig. 3 is a transverse vertical section. Fig. 4 is a central vertical longitudinal section. Fig. 5 is a top plan with steam-chest removed. Fig. 6 is a detail of one of the pistons. Fig. 7 is a detail of the cam. Figs. 8, 9, 10, and 11 are detail views showing the different positions of the controlling and reversing valve. Figs. 12 and 13 are detail views of the valve.

This invention has relation to certain new and useful improvements in rotary engines, wherein reciprocating pistons are employed to impart a rotary motion to a piston-cylinder; and the invention consists in the novel construction and combination of parts, as hereinafter described, and pointed out in the claims.

In the accompanying drawings, the letter A designates the outer cylindrical casing, having secured thereto the heads B and B′. Working in this casing and rigidly secured on a shaft C′, extended through the heads B B′ and having bearings *a a′* therein, is a rotary cylinder piston-wheel C, the diameter of which is sufficiently less than the interior diameter of the outer casing to leave a surrounding chamber *c*. Extending into this piston-cylinder from one end are a series (four being shown) of cylindric chambers D, which terminate a short distance from the opposite end *d* of said piston-cylinder. In each of these chambers is a cylindric piston E, of a length about one-half the depth of said chambers and adapted to reciprocate therein. The chambers D are formed around the central portion or core D′, through which extends the shaft C′, and in the end of said core is a circular socket *d*, which receives the shaft-bearing *a′*, formed in the interior surface of the head B′ of the outer casing. About midway of each piston-chamber is an exhaust-port *h′*, discharging into the chamber *c*. Each of the pistons E has therein a longitudinal slot *e*, and between the walls of this slot in each piston is journaled an anti-friction wheel or roller F. The walls of the slot extend beyond the periphery of this roller and the mouth thereof is of arcuate form, as shown at *f*. On the interior surface of the head B′, around the central shaft-bearing *a′*, is a circular cam G, having an oppositely-inclined edge *g* on which the anti-friction rollers F are designed to travel, being held thereto by the arcuate mouths *f* of the slots. To receive this cam, the walls of the piston-chambers are provided with the slots *h*, connecting their respective chambers. In the opposite end *d′* of the cylinder C are formed the arcuate ports *k*, one for each piston-chamber and communicating with the bottoms of said chambers. In the head B of the outer casing is formed the cylindric steam-chest H, in which is the main valve I. This valve comprises a circular rotary disk having on its outer face a surrounding marginal flange *i* at right angles thereto and cut away or reduced at one side, forming shoulders *j*, which are located at diametrically-opposite points. Said disk has a central perforation *j′*, which has a loose bearing on the cylindric shaft-bearing *a*, located centrally of said steam-chest. To one side of this central aperture is an arcuate slot or port *l* of a greater length than the ports *k* in the head of the piston-cylinder, against which the inner surface of the valve seats, but arranged to register therewith.

K is a segmental cut-off valve located within the flange *i* of the main valve and having a sleeve K′, loosely bearing on the cylindric shaft-bearing *a*. On the under surface of the valve K is an arcuate projection or lug *m*, which engages and travels in the arcuate slot or port *l*. This arcuate lug or projection *m* is arranged to one side of the center of said

valve K, so that when said valve is at the limit of its movement in one direction more of the port *l* will be uncovered than when it is at the opposite limit of its movement. On this valve K, at its marginal edge and at right angles to the plane of its movement, is a segmental gear L, which is extended in one direction therefrom, as shown at L′, the whole forming a segmental rack having an arc somewhat greater than a semicircle. Bearing in the side wall of the steam-chest and extending therethrough is a shaft M, provided at its outer end with a hand-wheel M′ or other means for its operation, and at its inner end carrying a pinion *p*, which engages the rack L L′.

The operation of the engine will now be explained.

The normal position of the valve I and its cut-off K is such that its port *l* is a little to one side of the highest point of the cam G. Steam being admitted through the supply-pipe P, it will pass through one of the ports *k*, against the corresponding piston E, forcing it longitudinally and causing its anti-friction wheel to travel down the incline of the cam. As the engagement of the arcuate slot *f* with the edge of said cam prevents said piston from turning in its cylinder-chamber, a rotary motion will be imparted to the cylinder C. In the meantime the port *k* of the next piston-chamber has been brought into position to receive steam and a corresponding movement is imparted to its respective piston. As the cylinder C continues to turn, each port *k* will in succession be brought into position to receive a port of steam and its respective piston forced to travel on the cam which remains in a stationary position. This operation is repeated, each piston successively receiving its head of steam when at about the highest point of the cam and exhausting through ports *h*′ into the chamber *c* when at the lowest point, and thence through the main exhaust-pipe R, communicating with said chamber. The distance between any two ports *k* is less than the length of the port *l*, so that a dead-center is impossible and the engine will start with the cylinder C in any position. On the under side of the valve I is an exhaust S for any steam remaining in the piston-chambers as the pistons are forced up the opposite incline by the operation of the succeeding piston. When it is desired to reverse the engine, the pinion-shaft M is turned, and by means of the rack and pinion and the connection between the valves I and K the valve I is turned, so that its port will occupy a position slightly to the opposite side of the highest point of the stationary cam G than it normally occupies, so that as steam is admitted to said port the pistons will be forced to travel down the opposite incline, turning cylinder C in the opposite direction. The valve I is capable of a movement through an arc of about one-half of a circle, being limited in both directions by the shoulder *j*, which engages the pinion-shaft at both limits of movement and serving as stops. It will be understood that any suitable number of the reciprocating pistons may be employed, the operation being the same. By means of the valve K the size of the steam-port *l* may also be regulated and the speed of the engine governed.

Having described this invention, what we claim, and desire to secure by Letters Patent, is—

1. In a rotary engine, the outer casing having a double-inclined cam secured to the inner surface of one of its heads, the rotary cylinder slotted to receive said cam, and having a series of alternately or successively reciprocating pistons therein and engaging said cam, substantially as specified.

2. In a rotary engine, the combination, with the outer cylinder or casing having a circular double inclined cam secured to the inner surface of one of its heads, of the rotary piston-cylinder having a series of successively-reciprocating pistons therein, said pistons having each a slot and anti-friction roller engaging and traveling on said cam, said slots extending below said rollers and formed with an arcuate mouth, substantially as specified.

3. The combination, with the outer casing or cylinder having the cam therein and stationary therewith, of the cylinder having a series of pistons therein, provided with ports and exhausts, by means of which they are alternately and successively reciprocated, said pistons having each an arcuate-mouthed slot engaging said cam, and an anti-friction roller in said slot, the piston-cylinder being also slotted to receive said cam, substantially as specified.

4. The combination, with the outer cylinder or casing and the cam secured to the inner face of one of its heads, of the rotary cylinder provided with slots to receive said cam and with a series of successively-reciprocating pistons engaging said cam, substantially as specified.

5. The combination, with the outer cylinder or casing and the cam secured to the inner face of one of its heads, of the rotary cylinder provided with a series of piston-chambers therein, slots connecting said chambers and receiving said cam, and pistons reciprocating in said chambers and provided with slots, and anti-friction rollers adapted to travel said cam, substantially as specified.

6. In a rotary engine, a rotary valve having an arcuate port and a marginal flange, a second valve located within said flange and arranged to partially cover said port, a connection between the two valves, and means for operating the said valves, substantially as specified.

7. In a rotary engine, a valve comprising a rotary disk provided with an arcuate port and with a surrounding marginal flange, a rotary segmental valve within said flange and axially arranged with relation to the first valve and adapted to partially close said port, said segmental valve having an arcuate lug engaging

said port and provided with a gear, means for actuating said gear and thereby the valves, and stops for limiting the movement of the said disk, substantially as specified.

8. The combination, with the outer casing having a steam-chest formed in one of its heads and provided with an interior cylindric shaft-bearing centrally of said chest, of a valve located within said steam-chest and provided with an arcuate port, said valve having a central bearing on said cylindric shaft-bearing, a segmental valve also having a bearing on said shaft-bearing, said segmental valve arranged to partially close said port and provided with a projection engaging the same, a gear on said segmental valve, a pinion meshing therewith, means for actuating said pinion, and stops for limiting the movement of said valves, substantially as specified.

9. The rotary engine comprising the outer cylindric casing having a steam-chest in one of its heads and a double inclined circular stationary cam on the interior of the opposite head, an inner rotary cylinder rigidly secured to a shaft having bearings in said heads, a chamber between the two cylinders, said inner cylinder having therein a series of successively-reciprocating pistons provided each with a groove and with an anti-friction roller traveling said cam, said inner cylinder also having slots to receive said cam, and suitable reversing-valve and exhaust mechanism, substantially as specified.

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

CHAS. W. DAKE.
EDWARD B. DAKE.

Witnesses:
HARVEY L. WHITE,
EDWARD VANPELL.