No. 777,108. PATENTED DEC. 13, 1904.

C. KING.

RECIPROCATING ENGINE.

APPLICATION FILED JAN. 12, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig 1.

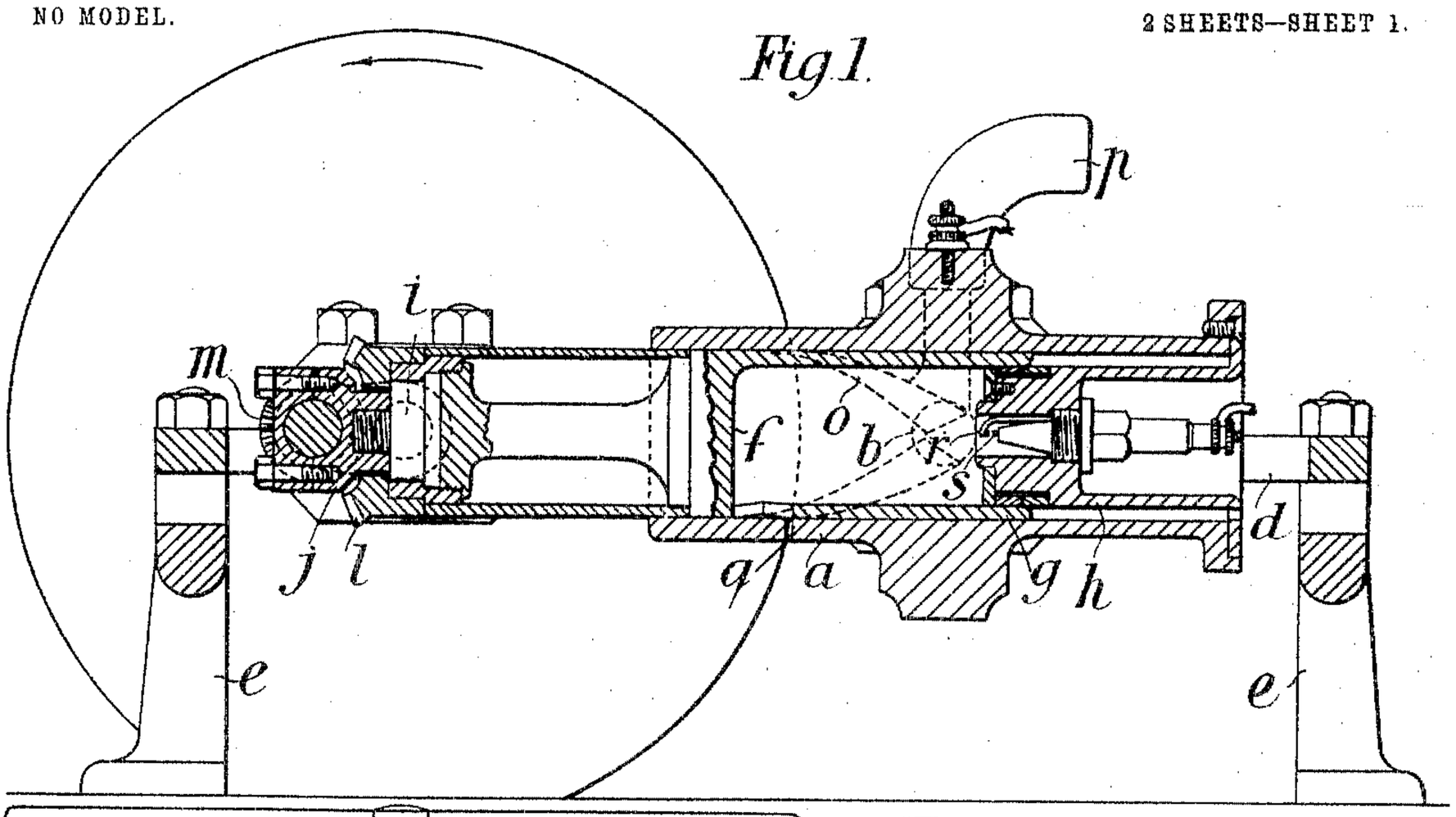


Fig 2

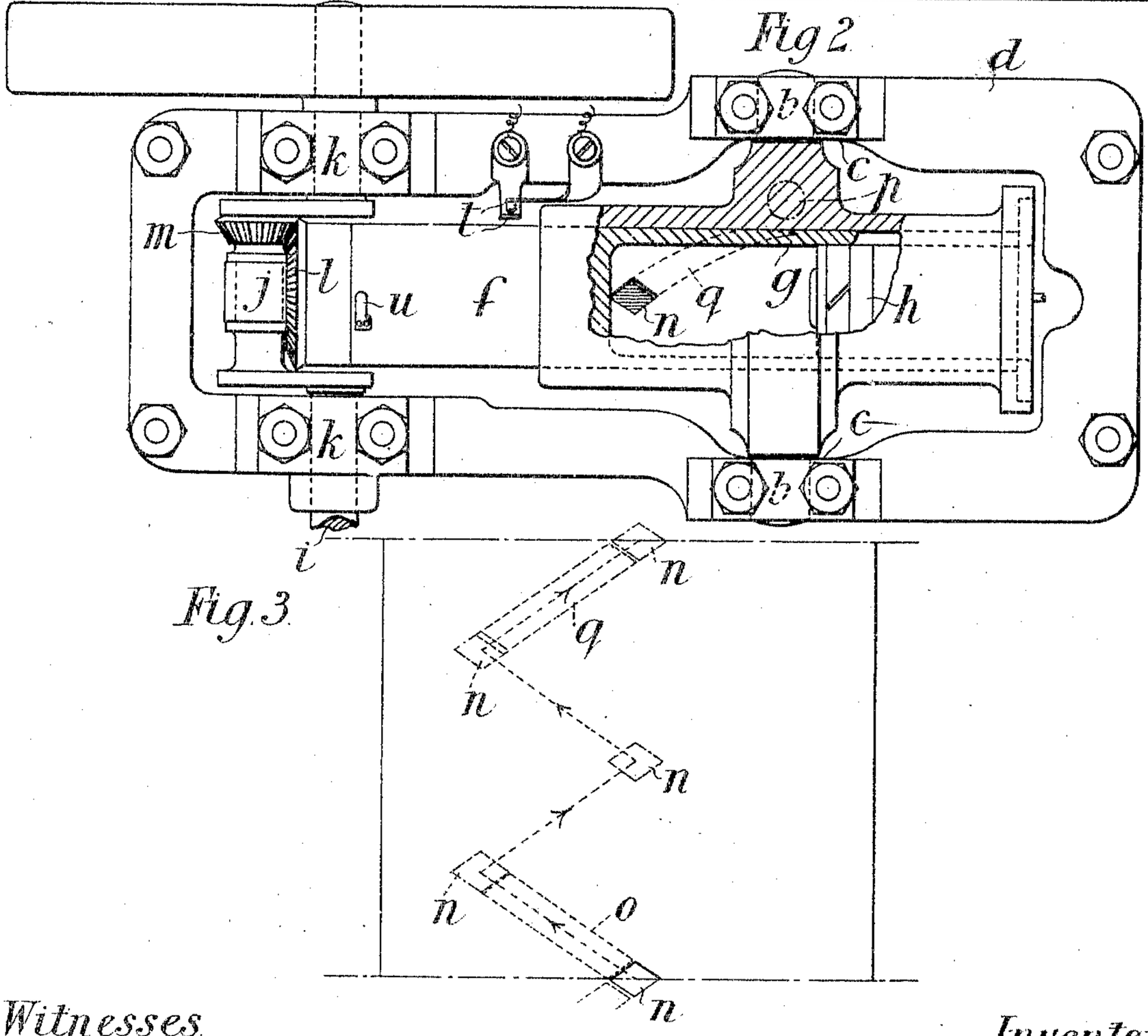


Fig 3.

Witnesses.
C. K. Moore
F. H. Hubbard

Inventor.
Charles King
By Whittaker & Prentiss.
Attys.

No. 777,108. PATENTED DEC. 13, 1904.

C. KING.

RECIPROCATING ENGINE.

APPLICATION FILED JAN. 12, 1904.

NO MODEL. 2 SHEETS—SHEET 2.

Fig. 4.

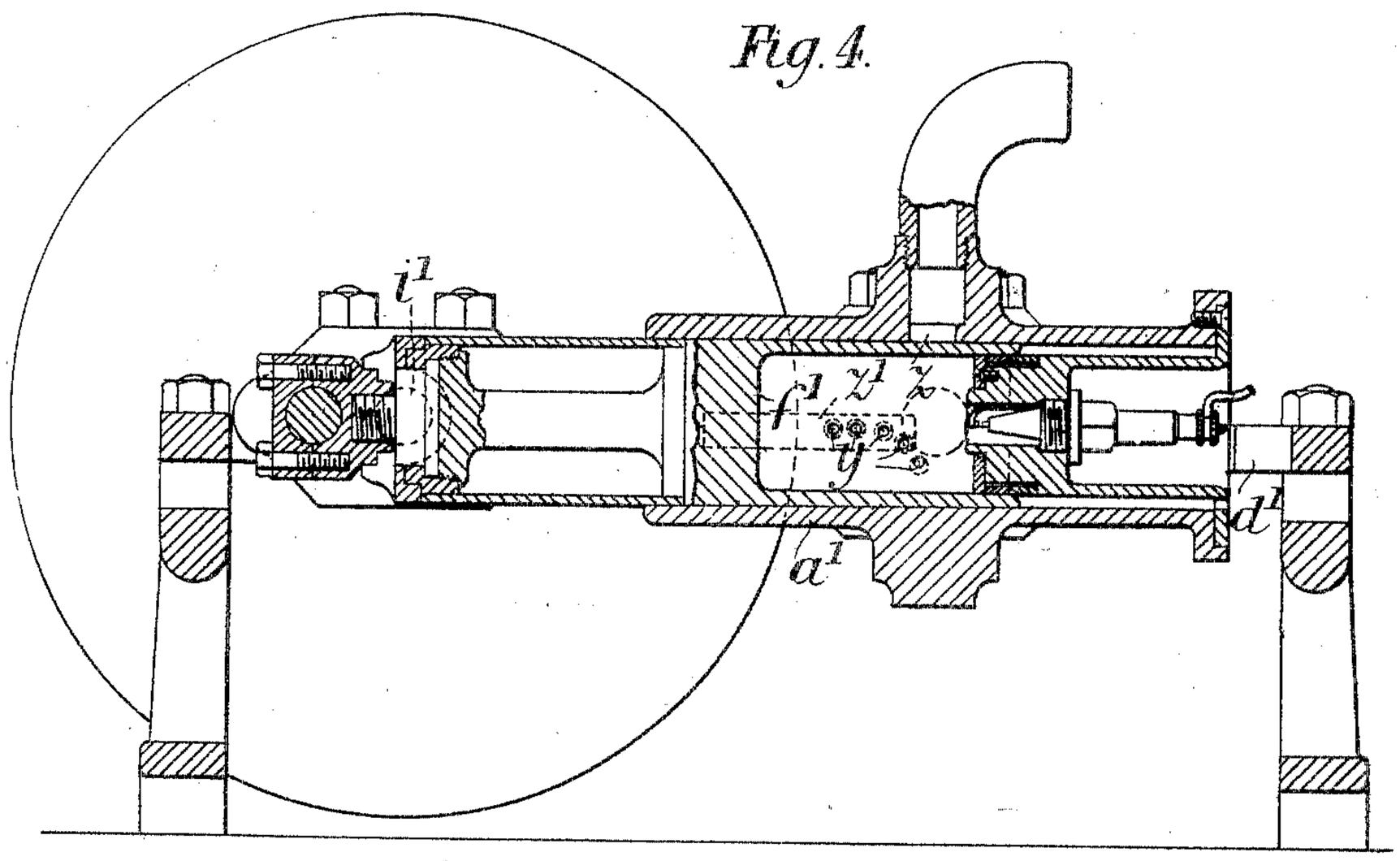


Fig. 5.

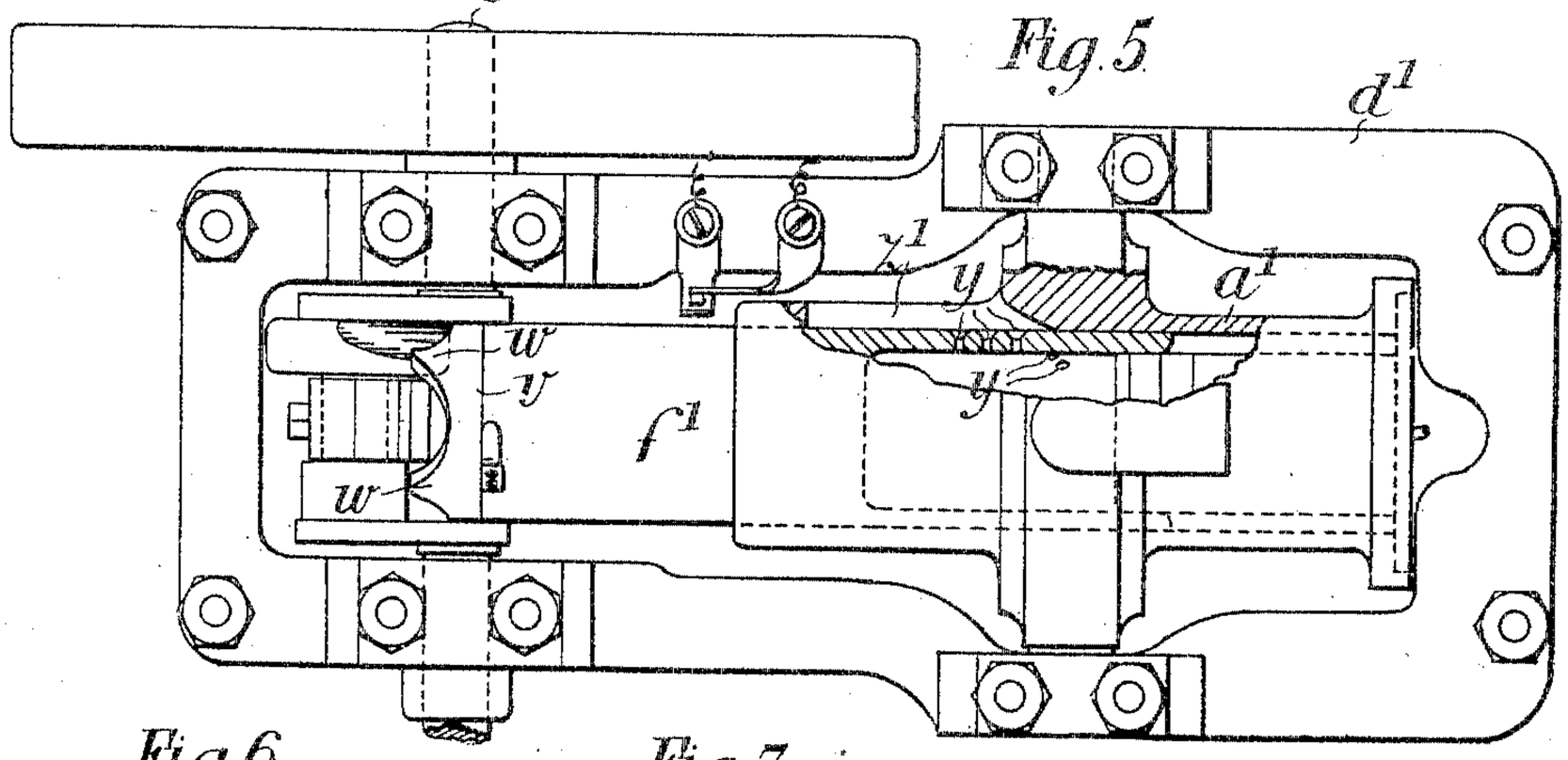


Fig. 6.

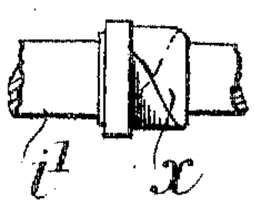


Fig. 7.

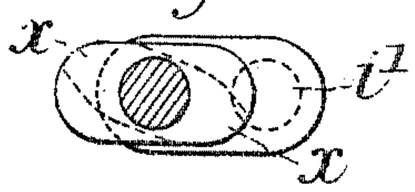


Fig. 8.

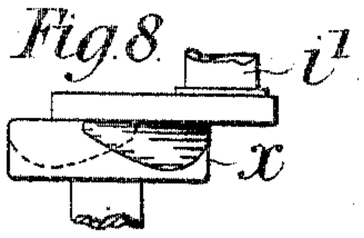


Fig. 9.

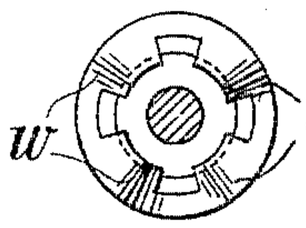
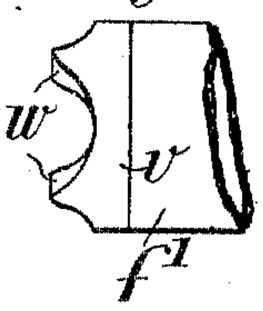


Fig. 10.



Witnesses.
J. R. Moore
P. H. Hubbard

Inventor.
Charles King
By Whittaker & Prescott
attys

No. 777,108. Patented December 13, 1904.

UNITED STATES PATENT OFFICE.

CHARLES KING, OF ASHFORD, ENGLAND.

RECIPROCATING ENGINE.

SPECIFICATION forming part of Letters Patent No. 777,108, dated December 13, 1904.

Application filed January 12, 1904. Serial No. 188,711. (No model.)

To all whom it may concern:

Be it known that I, CHARLES KING, a subject of the King of Great Britain, residing at The Grange, Ashford, county of Middlesex, England, have invented new and useful Improvements in Reciprocating Engines, of which the following is a specification.

This invention relates to reciprocating engines operated by the explosion of combustible vapor or gas or by steam, compressed air, or other expansive fluid, the object being to provide what is practically a valveless engine.

According to the invention I construct my improved engine of a cylinder, a piston, and a crank-shaft with a fly-wheel, as usual; but in lieu of the ordinary inlet and exhaust valves I provide for effecting the admission and exhaust by imparting rotary motion to the piston, which has a port or ports adapted to act in conjunction with ports in the cylinder.

In the accompanying drawings, Figure 1 is a longitudinal section of one form of internal-combustion engine constructed according to the invention. Fig. 2 is a sectional plan view thereof; and Fig. 3 is a development of the cylinder, showing the inlet and exhaust ports therein. Fig. 4 is a longitudinal section of a modified construction of internal-combustion engine constructed according to the invention. Fig. 5 is a sectional plan view thereof, and Figs. 6 to 10 are views of details hereinafter described.

Referring first to the arrangement illustrated in Figs. 1 to 3, *a* represents the cylinder, which is provided with trunnions *b*, mounted in bearings *c c* upon a bed-plate *d*, resting upon suitable supports *e*. *f* is the piston, which is adapted to be reciprocated within the cylinder *a*, the inner end of the piston *f* being provided with a tubular extension *g*, fitting over a plug *h* in the outer end of the cylinder *a*. The piston proper, *f*, is hollow and is directly coupled with the crank-shaft *i*, mounted in bearings *k k* upon the bed-plate *d*, the connection being effected by the end *j*, the base of which is rotatably held in the end of the piston *f*. The outer end of the piston *f* has rigidly secured to it the bevel-wheel *l*, which gears with the bevel-wheel *m*, keyed upon the crank-shaft *i*, so that as the said crank-shaft *i* is rotated by the reciprocation of the piston the gear-wheel *m* rotates the wheel *l*, and thereby imparts rotary motion to the piston *f* within the cylinder *a*. In the arrangement shown in the drawings the bevel-wheel *m* is half the diameter of the bevel-wheel *l*, so that the piston *f* makes one revolution for every two revolutions of the bevel-wheel *m* or crank-shaft *i*. The piston is provided with a port *n*, which as it rotates is brought into coincidence with the inclined inlet-port *o* in the cylinder *a*, to which port the motive fluid is supplied through the pipe *p* and with the exhaust-port *q* in the cylinder, which is merely an inclined slot formed in the wall of the cylinder, as clearly indicated in Figs. 1 and 2.

The engine illustrated is arranged to work on the Beau de Rochas or Otto cycle, and during the first outstroke of the piston *f* combustible vapor is drawn through the pipe *p* and ports *o* and *n* into the tubular extension *g* of the piston, the said piston being rotated through a quarter of a revolution during this outstroke. With the first return stroke the charge is compressed in the usual way, the piston being rotated a further quarter of a revolution. The charge is then ignited and during the next outward or working stroke of the piston the latter is rotated a further quarter of a revolution, which brings the port *n* opposite the exhaust-port *q*, so that during the final or exhaust stroke the products of combustion escape through the said port *q* into the atmosphere, the cycle then beginning *de novo*.

Although the engine above described operates upon the Otto cycle, it will be clear that any other of the usual cycles can be made use of. The ignition is preferably effected by means of an electric spark, although other forms of ignition can be employed, if desired. In the drawings, *r* and *s* represent the sparking points, *t* a switch in the primary circuit, which is normally broken, and *u* a cam-surface or tappet on the rotating piston, which strikes the switch *t* once each revolution and so completes the electric circuit and causes sparking to take place.

In the engine illustrated in Figs. 4 to 10 the

cylinder a' oscillates upon the bed-plate d' in the same manner as in the arrangement before described, and the piston f' is directly connected to the crank-shaft i' also in the same manner. In lieu, however, of continuously rotating the piston, as before, I now provide for intermittently rotating the same, and for this purpose the end of the piston is provided with a disk v, having a number of gear-teeth w, with which engage gear-teeth or cam-surfaces $x\,x$ upon the crank. Figs. 6, 7, and 8 are an end view, a side view, and a plan, respectively, illustrating the gear or cam teeth upon the crank-pin, while Figs. 9 and 10 are respectively an end view and a side view of the teeth upon the end of the piston. Furthermore, in this arrangement a number of port-holes $y\,y$ are provided in the piston itself, the said holes following a curved path, as shown in Fig. 4, and the intermittent rotation of the piston bringing these ports successively under the simple inlet-port z and the elongated outlet-port z', provided in the cylinder a'. The cylinder instead of being arranged to oscillate may be stationary. In this case the piston is connected to the crank by a rod in any suitable manner and rotary motion is imparted to the piston by the means as aforesaid or by other suitable means.

When the engine is to be operated by steam or other expansive fluid, the piston is arranged to make one rotation or more or less for each rotation of the crank-shaft, and apertures are formed in the cylinder as required for the admission and also for the exhaust, so that the piston receives an impulse at each revolution instead of at every other revolution, as in the case of an internal-combustion engine.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a reciprocating engine, the combination of a cylinder, a piston, a crank-shaft rotated by the piston, means for rotating the piston in the cylinder to control the distribution of the motive fluid, an igniting device and igniter-controlling mechanism including a part carried by said rotating piston, substantially as described.

2. In a reciprocating engine, the combination of a cylinder, a piston, a crank-shaft rotated by the piston, means for rotating the piston in the cylinder to control the distribution of motive fluid, an igniting device, igniter-controlling mechanism mounted on a stationary part and a cam mounted on the rotating piston for engaging and operating the igniter-controlling device, substantially as described.

3. In a reciprocating engine, the combination of a cylinder, a piston, a crank-shaft rotated by the piston, means for rotating the piston in the cylinder to control the distribution of motive fluid, an igniting device, a circuit-controller for said igniter mounted on a stationary part and having a movable contact and a cam mounted on said rotating piston for engaging said movable contact, substantially as described.

4. In a reciprocating engine, the combination of an oscillating cylinder, a piston, a crank-shaft rotated by the piston, a tubular extension at the rear of the piston, ports in the cylinder and piston extension and toothed gear, such as bevel-gear, for rotating the piston from the crank-shaft, substantially as described.

5. In a reciprocating engine, the combination of an oscillating cylinder, a piston, a crank-shaft rotated by the piston, a tubular extension at the rear of the piston, ports in the cylinder and piston extension, means for rotating the piston in the cylinder and an igniting device controlled by the rotating piston, such as a cam-surface on the said piston for making and breaking an electric circuit, substantially as described.

6. In a reciprocating engine, the combination of an oscillating cylinder, a piston, a crank-shaft in connection with the piston, a bevel-wheel upon the crank-shaft, a bevel-wheel upon the piston, gearing with the bevel-wheel upon the crank-shaft for continuously rotating the piston as it reciprocates in the cylinder, and ports in the cylinder and piston extension, substantially as described.

7. In a reciprocating engine the combination of a cylinder, a piston, a crank-shaft in connection with the piston, teeth upon the crank-shaft, teeth upon the piston end gearing with the teeth upon the crank-shaft for imparting an intermittent rotary motion to the piston as it reciprocates in the cylinder, and ports in the cylinder and piston extension, substantially as described.

CHARLES KING.

Witnesses:
JOHN E. BOUSFIELD,
C. H. JAMES.