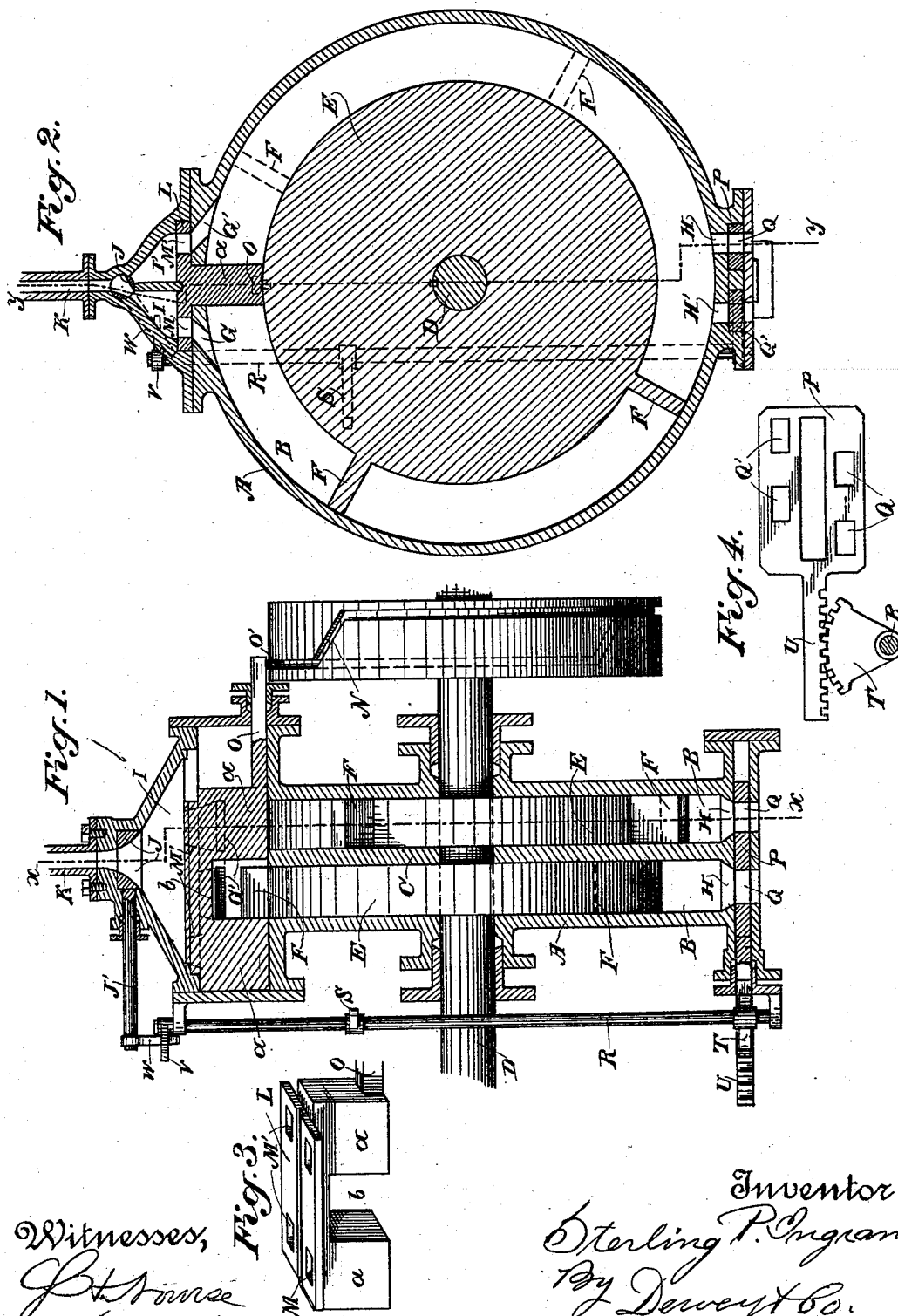


(No Model.)

S. P. INGRAM.  
ROTARY ENGINE.

No. 553,408.

Patented Jan. 21, 1896.



Witnesses,  
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# UNITED STATES PATENT OFFICE.

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## ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 553,408, dated January 21, 1896.

Application filed October 28, 1895. Serial No. 567,054. (No model.)

*To all whom it may concern:*

Be it known that I, STERLING P. INGRAM, a citizen of the United States, residing at San José, county of Santa Clara, State of California, have invented an Improvement in Rotary Engines; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to a rotary engine.

It consists in details of construction which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is a vertical section on line *yy* of Fig. 2. Fig. 2 is a vertical section on line *xx* of Fig. 1. Fig. 3 is a detail view of the slide-valve to control the steam-inlet. Fig. 4 is a plan view of the slide-valve to regulate the exhaust.

A is the cylindrical case of my engine, having chambers B B upon opposite sides of a central diaphragm C. Through the center of this case and diaphragm passes a shaft D, suitably journaled at the outer ends, and upon this shaft are fixed disks E E, adapted to rotate within the chambers at opposite sides of the diaphragm. Fixed to each of these disks and extending radially therefrom are two pistons F, fitting within the annular chamber, which is formed exterior to the disk and suitably packed, so as to form steam-tight joints between them and the inner peripheries and sides of the chambers. These disks are situated at such a distance apart as to inclose a space approximately equal to the distance to which the steam follows the second piston, no steam being admitted between the two.

At the top of the case, opening into each of the annular piston-chambers, are the steam-inlet ports G G'. At the bottom of the case are the exhaust-ports H and H'.

The two sets of pistons F are so arranged with relation to each other that steam is admitted to act upon them alternately in the two annular piston-chambers, and the action upon the driving-shaft is thus approximately continuous.

Upon the top of the case is fixed a steam-chest, which is divided into two parts I and I' by an intermediate diaphragm. This steam-chest connects at the bottom with the ports G and G' and diminishes toward the top where

a transverse rotary inlet-valve J is fitted into a suitable valve-chamber. This valve has a port passing through it enlarged at the upper side, so as to connect with the steam-inlet passage K, and diminishing toward the lower side, so that when this valve is turned to one point the steam-passage connects the inlet K with the valve-chamber I. When turned to another point it connects with the chamber I', so that when the steam is admitted to one of these chambers the engine will be rotated in one direction, and when admitted to the other it will be reversed and rotated in the opposite direction.

The admission of steam to the piston-chambers is controlled by a transversely-sliding valve L, having ports M and M' made through its face, and adapted to coincide at proper intervals with the ports G or G', according to the direction in which the engine is to move. Upon the shaft D is fixed a double cam N.

The valve has a stem O extending outwardly through the side of the valve-chamber, and this stem has an arm O' which enters the groove or channel in the cam N, so that as the cam and shaft rotate, the valve-stem will be moved and the valve shifted so as to alternately admit steam into one of the piston-chambers and then the other through the respective ports M or M' which may at the time be in use.

The exhaust-ports H and H' correspond with the steam-ports G and G'—that is, when steam is admitted through the port G to drive the pistons in one direction, the exhaust-port H, which is farthest away from this port, is the one through which the exhaust takes place, and correspondingly when the engine is reversed and steam is admitted through G' the exhaust-port H', farthest from this port, will be the one through which the steam escapes.

When one of the exhaust-ports is being used, the other will be closed by means of a slide P which moves transversely and which is provided with openings Q upon one side and Q' upon the opposite side. These openings are so arranged with relation to each other that when this valve or slide is moved so that one set of openings, Q, coincide with one set of exhaust-passages, H, the other open-

ings, Q', will be out of line with the exhaust-openings H', and these latter will thus be closed.

The valve J and the slide P are actuated in unison by means of a vertical shaft R suitably journaled exterior to the case A having a lever-arm S by which it may be rotated within fixed limits by the operator.

Upon the lower end of the shaft R is fixed a toothed segment T, and this engages with a rack U which is fixed upon an extension of the slide P, so that by the rotation of the shaft R and the movement of the segment T, the slide P will be moved so as to open or close the ports Q or Q'. Upon the upper end of the shaft R is an arm V, and this engages with a rocker-arm W, which is fixed upon the projecting shaft J' of the valve J. These connections may be made in various ways which would be mechanically equivalent to those here described. In the present case the arm V rotating in a horizontal plane forms contact with the arm W which rotates in a vertical plane, so that when the arm V is turned a short distance it acts to move the arm W up or down, as the case may be, and thus rotate the valve J the short distance which is necessary to reverse the steam-inlet port.

In conjunction with the transversely-sliding valve L are the abutments a, which are fixed to and movable in unison with the valve. These abutments have a depth equal to the distance between the periphery of the disk E and the inner periphery of the piston-chamber, so that when either one of them lies across the chamber it cuts it off from the other part at that point. These abutments are slidable between the ports G and G' and they are separated so as to leave a passage b between them equal to the width of the piston-chamber and the piston.

When the front piston in either chamber approaches the abutment the cam N acting upon the stem O moves the valve and the abutment so that at the instant when the piston arrives at the abutment the latter will be withdrawn, so that the passage b coincides with the piston-chamber, and the piston passes through the space thus formed. An instant after the second piston has passed the abutment the action of the cam moves the abutment, so as to close this channel, and at the same time to bring the ports M M' to coincide with the ports G and thus allow the steam to enter the chamber behind the rear-most of the pistons F. The steam acting upon this piston carries it around within its chamber until it passes the exhaust-port H, when the steam escapes through this port, and at this instant the abutment and valve are shifted so that steam will be admitted into the opposite piston-chamber, the two thus acting alternately to drive the shaft.

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

1. A rotary engine consisting of a cylin-

drical case having a vertical intermediate diaphragm transverse to the axis, chambers formed between said diaphragm and the ends of the case upon opposite sides, a shaft extending centrally through the axis of the case, disks fixed to said shaft revoluble within the respective chambers of the case, radial pistons fixed in pairs upon each disk, steam ports at the upper part of the case, exhaust ports at the lower part, a transversely moving valve and abutments fixed to and movable with said valve whereby steam is admitted behind the rearmost piston in each of the piston chambers alternately and discharged from the corresponding exhaust passage at the bottom.

2. A rotary engine consisting of the cylindrical case having annular piston chambers upon opposite sides of a central diaphragm, a shaft extending axially through the case, disks fixed to the shaft having pistons fixed in pairs upon their peripheries and movable within the respective annular piston chambers, steam inlet passages formed in pairs at the top of the case, a steam valve chest having a vertical diaphragm separating it into two parts, a transversely movable valve with inlet ports corresponding with those of the engine case, and with the two valve chambers, a rotary inlet valve with a passage whereby steam may be admitted to either of the valve chambers, and the motion of the engine reversed, and corresponding exhaust passages formed at the bottom of the case with valves whereby one is opened and the other closed in unison with the movement of the steam inlet valve to reverse the motion of the engine.

3. A rotary engine consisting of a cylindrical case having annular piston chambers upon opposite sides, an axial shaft passing through said case having disks fixed thereto and rotary pistons fixed to the disks in pairs to rotate within the respective piston chambers, a transversely movable abutment slotted so as to allow either pair of pistons to pass through it when the slot is in line with the piston chamber and closable behind the rear piston, a steam chest having ports leading into the piston chambers upon opposite sides of the line of travel of the abutment, a valve fixed to and movable in unison with the abutment, having ports corresponding with those in the steam chest, a diaphragm separating the steam chest into two parts in each of which one half of the valve is movable, an inlet passage and valve whereby steam may be diverted to either of the valve chambers for the purpose of reversing the engine, exhaust passages at the lower side of the piston chambers corresponding with the inlet passages, and a valve whereby one pair of said exhaust passages is opened and the other closed upon each reversal of the engine and a connecting mechanism whereby the inlet valve and the exhaust valves are reversed simultaneously.

4. A rotary engine consisting of a case hav-

ing annular piston chambers upon opposite sides of a central diaphragm, a central shaft with disks fixed thereto, rotary pistons fixed to the disks in pairs and movable within the annular piston chambers, a two part valve chamber with means for admitting steam to either portion, a corresponding two-part valve movable transversely within the valve chamber, having ports corresponding with ports which open into the piston chambers in line with the two valve chambers, an intermediate slotted abutment fixed to and movable with the valve whereby the piston chambers are alternately opened for the passage of the pistons and closed behind them, exhaust passages at the bottom of the case corresponding with the inlet passages at the top, a trans-

versely movable slide with ports corresponding with the exhaust passages whereby one pair of exhaust passages is closed when the engine is moving in one direction, and the other when it is moving in the opposite direction, a vertical oscillating shaft journaled exterior to the engine case having connection with the lower end whereby the exhaust valve slide is moved and connection with the upper end whereby the inlet valve is simultaneously operated to reverse the engine.

In witness whereof I have hereunto set my hand.

STERLING P. INGRAM.

Witnesses:

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