(No Model.) 2 Sheets—Sheet 1.

A. F. G. BROWN.

ROTARY ENGINE.

No. 420,331. Patented Jan. 28, 1890.

Fig. 3.

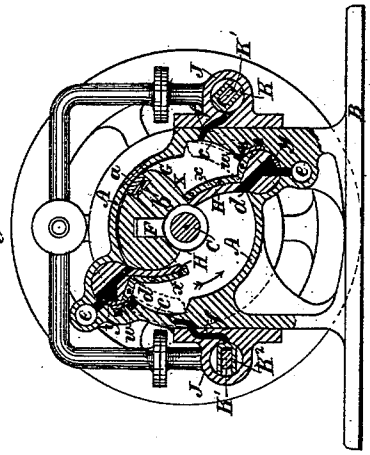


Fig. 4.

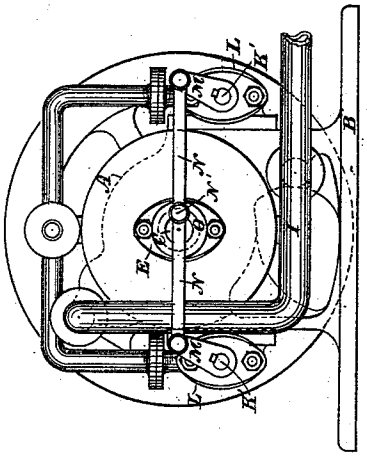


Fig. 5a.

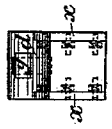


Fig. 1.

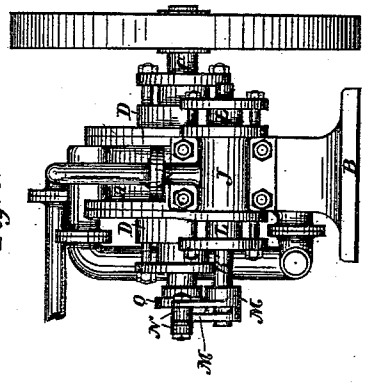
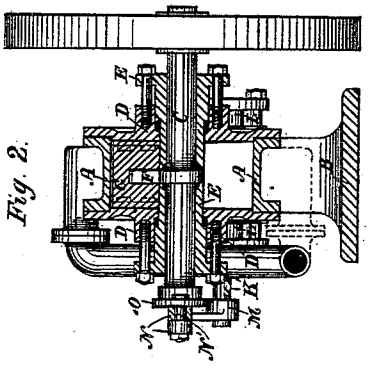


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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ROTARY ENGINE.

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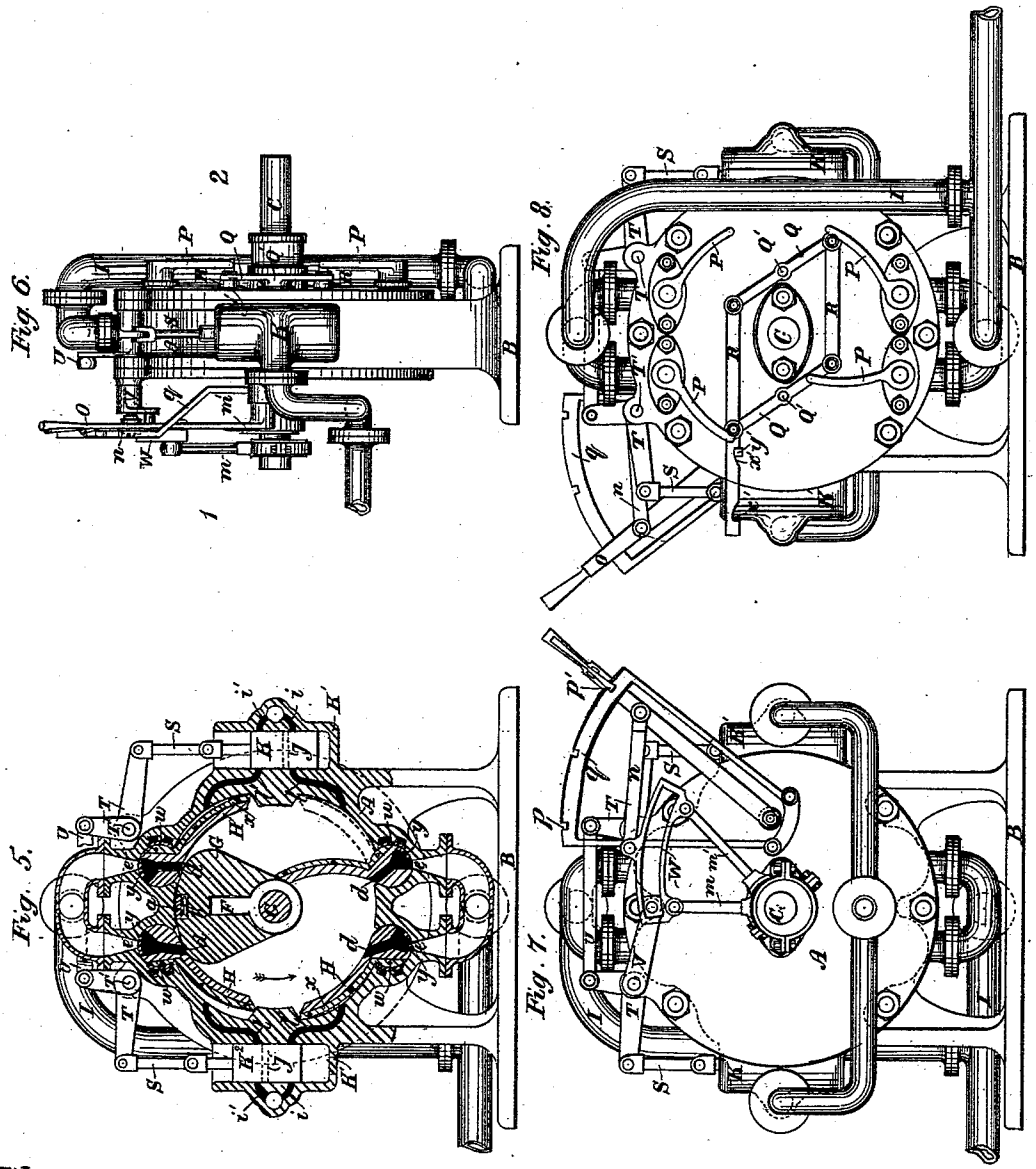

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UNITED STATES PATENT OFFICE.

ALEXANDER F. G. BROWN, OF DALRY, COUNTY OF AYR, SCOTLAND.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 420,331, dated January 28, 1890.

Application filed December 1, 1888. Serial No. 292,399. (No model.) Patented in England February 2, 1888, No. 1,555.

To all whom it may concern:

Be it known that I, ALEXANDER FRANCIS GARDEN BROWN, a citizen of the United Kingdom of Great Britain and Ireland, residing at Swindridge Muir, Dalry, in the county of Ayr, Scotland, have invented new and useful Improvements in Rotary Engines, (which have not been patented in any country except Great Britain, by Letters Patent dated the 2d day of February, 1888, No. 1,555;) and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art or manufacture to which it relates to make and use the same.

This invention relates to improvements in single-acting and in reversing rotary engines, the improved engine being capable of working as a compound engine, or with triple, quadruple, or other number of expansions.

On the accompanying drawings, Figure 1 is a side elevation of a single-acting rotary engine constructed in accordance with my improvements; Fig. 2, a longitudinal section thereof; Fig. 3, a transverse vertical section thereof, and Fig. 4 an end elevation thereof. Fig. 5 is a transverse vertical section of a reversing rotary engine as constructed in accordance with my improvements. Fig. 5^a shows the packing-strips. Fig. 6 is a side elevation thereof; Fig. 7, an elevation of the end marked 1; and Fig. 8, an elevation of the end marked 2, Fig. 6.

As shown by Figs. 1, 2, 3, and 4, the improved single-acting engine consists of a cylinder A, the body of which is formed on or connected to a sole or base plate B, both ends of the cylinder being removable. Through the center of the cylinder there extends a shaft C, which passes out through stuffing-boxes D, the glands E of which are so formed that they project into the body of and toward the center of the cylinder, thus constituting hollow sleeves or bosses surrounding the shaft C. In the space between the inner ends of the glands E there is secured on the shaft the eye or boss of a radial or crank arm F, whose outer end extends into a recess made in a piston-piece G, the piston-piece occupying the full breadth of the cylinder between its removable ends. The inner edge of the piston-piece rests steam-tight upon and rotates around the glands E, which are capable of being screwed up to provide for wear of the sides of the eye of the crank-arm F, against which the glands abut. At its outer edge the piston-piece G is packed by a packing-strip *a*, extending across the breadth of the piston in a slot or recess made for its reception, the packing-strip being held tight against the interior of the cylinder by springs *b*, placed in the recess behind it. In addition to the said packing *a*, the ends of the piston may be packed by similar strips and springs acting against the removable ends or covers of the cylinder. In conjunction with the piston G there are provided two arms H H′, one end of each of which is situated in a recess made in the thickness of the cylinder for its reception, the interior bore of the cylinder being also recessed, as seen at *c*, Fig. 3, to receive the other ends of these arms as they are pushed back successively by the piston during its rotation. The arms H H′ also extend across the full breadth of the cylinder between its removable ends, against which they are packed steam-tight by the packing-strips *x*, (seen at Fig. 5^a, which is a side elevation of one arm.) The bosses of the said arms have steam ways or passages *d* formed in them, which communicate with exhaust-passages *e*, made in the cylinder, and with an exhaust-pipe I. The end of the steamway has or may have a piece *y* fitted into it which is forced tight against the exhaust-passage *e* by the pressure of steam behind it, and in addition to the packing-strips *x* another packing for the arms may be inserted at *w*.

The inner ends of the arms H H′ are so formed that when extended they rest steam-tight against the glands E and eye of the crank-arm F, and the recesses *c* in the cylinders, in which these arms lie when moved back by the rotating piston G, are preferably so shaped that when the arms are thrown back there is a space between the surfaces of the arms and of the recess, as indicated in dotted lines at Fig. 3.

The cylinder A has a valve-box J at each side, from which a port *f* extends into the recess *c*, so that the said ports are covered by the arms H H′ when they are thrown back

by the piston G. In the valve-boxes J any suitable arrangement of steam-distributing valve may be employed.

The valves K K^2, (shown on the drawings,) are oscillating valves, the spindles K′ of which pass out through stuffing-boxes L, and have cranks M secured on their outer ends, these cranks being connected by links N to a pin N′, fixed eccentrically in a disk O, keyed on the shaft C, or instead of this any other suitable arrangement of valve-gear, and by the rotation of which the valves K K^2 will operate to supply and cut off steam alternately, may be substituted.

In starting the engine constructed as hereinbefore described steam is admitted so as to act on the side X of the piston, the opening of the steam-port having the effect of first forcing the arm H down the face of the piston G, until the inner end of the arm is in contact with the glands E, the steam being thereby prevented from acting except to rotate the piston in the direction of the arrow, Fig. 3. At the same time the exhaust-passage *d* in the hub or boss of the arm H so forced down is opened to that part of the cylinder which receives steam from the other distributing-valve K^2 and to the port *e*, thereby exhausting the steam from that part of the cylinder and preventing back-pressure on the rotating piston. Immediately on passing the position shown at Fig. 3 the piston G begins to act on the other arm H′ and to push it into its recess *c*, from which it is again forced down by the pressure of steam supplied through the port *f*, opening to the said recess when the face X of the piston has passed that point.

When arranged to reverse, the engine, as seen by Figs. 5, 6, 7, and 8, is provided with two sets of arms H, one set of which remain dormant while the piston G is rotating in one direction, and the other while the piston is rotating in the opposite direction. The boss of each arm (in which exhaust-ports *d* are formed, as before described) has a spindle secured in one end of it, the said spindle passing through a stuffing-box and gland in one of the removable covers of the cylinder and having a lever or crank P keyed upon it. In conjunction with the said levers or cranks there is provided a parallel motion, (seen more particularly at Fig. 8,) and which consists of two levers Q, centered upon the cylinder-cover at Q′ and having their ends connected by links R, the connecting-pins projecting and acting as stops to the movement of one set of the levers P and the arms H, to which these levers are connected, according to the position of the said levers and links. At each side of the cylinder a piston distributing-valve K is situated in a valve-casing K′, which has two steam-ports *i i′*, one port *j* being formed through the valve which is brought into communication with the port *i* or *i′*, and with distributing-ports *l l′*, made in the cylinder, accordingly as one or other of the sets of arms H are in operation. The piston-valves K K^2 are connected by links S to bell-crank levers T, centered upon studs T′, the upper arms of the levers being coupled by a link U. On one of the studs or spindles T′ a lever V is keyed, the other end of the said lever being connected to a block sliding in the slot of a reversing-link W, to which eccentrics *m m′*, for actuating the valves K K^2, are attached, the eccentrics being situated upon the main shaft C. The reversing-link W is connected by a link *n* to a lever *o*, centered at its lower end on one of the cylinder-covers, the said lever being provided with a spring-catch which takes into notches *p p′* in a quadrant *q*, also secured to the cylinder-cover. One eccentric is provided for forward and the other for backward rotation of the piston G, the valves K K^2 being shifted to supply steam through the ports *l* or *l′* of the cylinder, as desired, by operating the lever *o*, the movement of the lever to the notch *p′* having the effect of bringing the eccentric *m* into action and of supplying steam through the ports *l*, and of actuating the arms H, (shown to be in operation on Fig. 5,) the effect of which is to rotate the piston in the direction of the arrow, while the shifting of the lever to the notch *p* brings the port *j* of the piston into position to supply steam to the cylinder through the ports *l′*, so, in conjunction with the other set of arms H, actuating the piston in the opposite direction, the arms H, which are for the time being out of action, being held stationary by their levers P and the parallel motion Q R, as before described. To supply steam through the port *l′* the rod of the eccentric *m′* must be made longer than that of the eccentric *m*. One link R of the parallel motion is extended, the extension having notches *x′* cut in it, one of which engages with a pin or stud *y′*, projecting from the cylinder-cover, and by so preventing vibration of the parallel motion holds one set of levers P and arms H in their dormant position until the direction of rotation of the piston is reversed, in which case the steam, acting on the back of the previously-dormant arms H, automatically shifts the levers Q and links R until the other notch *x′* engages with the stud *y′*, or instead of this motion any other suitable valve motion may be adopted.

The improved engine, constructed either as a single-acting or reversing engine, may be made to work expansively by arranging the valves K K^2 to cut off steam at any desired part of the stroke of the piston G, and by the employment of two or more cylinders, the exhaust-ports of the first of which communicate with the steam-ports of the next in series, the engine may be adapted to operate as a compound engine, or as an engine with triple, quadruple, or other number of expansions.

Having now described the invention, what I desire to claim, and secure by Letters Patent, is—

1. In a rotary engine, the combination of a

cylinder having its interior recessed, as set forth, with admission-ports leading from distributing-valves to said recesses, a rotating segmental piston in said cylinder carried upon a crank on the main shaft, and two or more arms arranged to alternately lie in and to be extended to the piston-face from said recesses, said arms having exhaust-ports therein, substantially as described.

2. In a rotary engine, the combination of arms arranged to alternately lie in recesses within the cylinder and to be extended therefrom to the piston-face, spindles extending from said arms through an end of the cylinder, levers on said spindles, and a parallel motion arranged according to its position to hold said arms out of action, substantially as described.

In witness whereof I have hereunto set my hand this 15th day of October, 1888.

ALEX. F. G. BROWN.

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