(No Model.)

3 Sheets—Sheet 1.

J. C. JARVIS.

ROTARY ENGINE.

No. 383,530. Patented May 29, 1888.

Fig. 3.

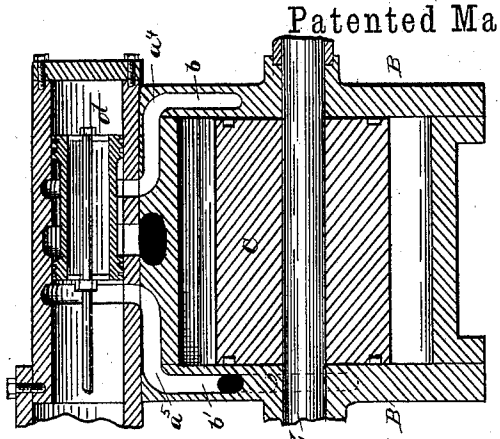


Fig. 2.

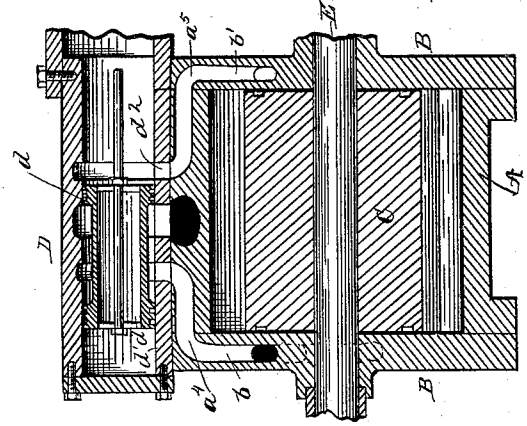
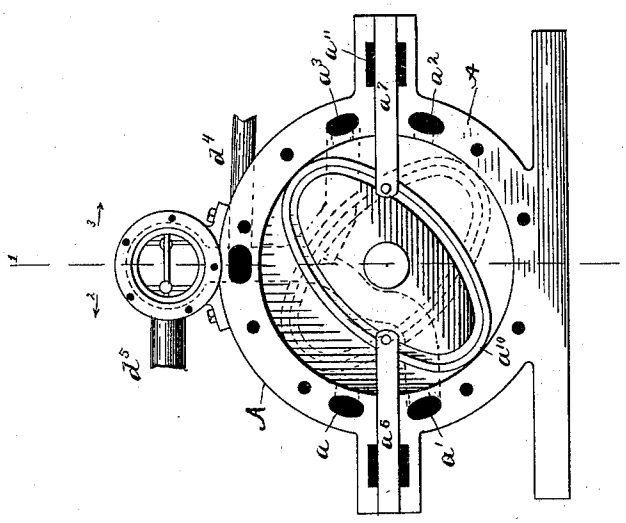


Fig. 1.



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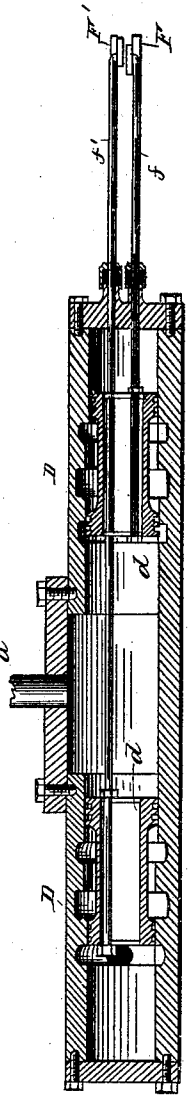
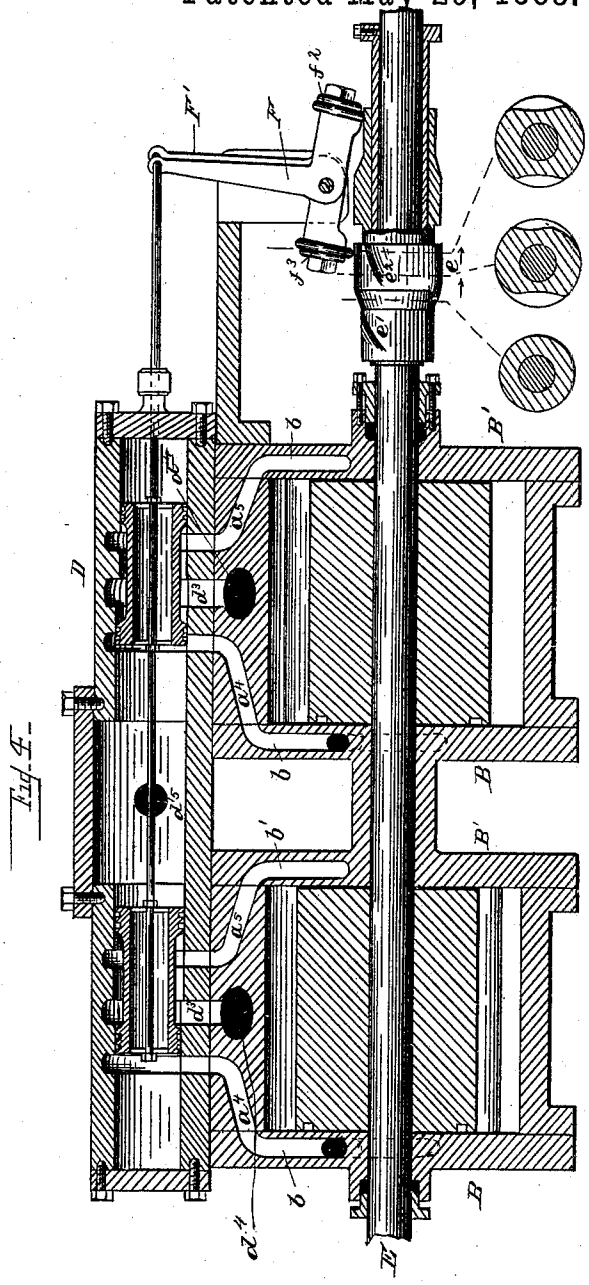


Fig. 4.



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Fig. 7.

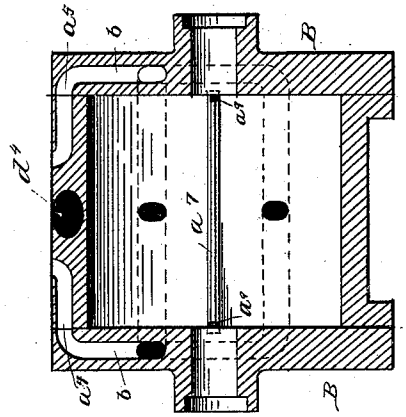
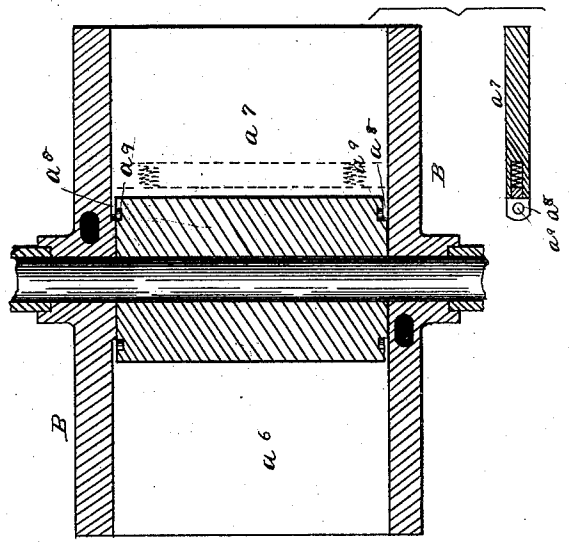


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOSEPH C. JARVIS, OF HUNTINGTON, WEST VIRGINIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 383,530, dated May 29, 1888.

Application filed July 25, 1887. Serial No. 245,252. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH C. JARVIS, a citizen of the United States, residing at Huntington, in the county of Cabell and State of West Virginia, have invented certain new and useful Improvements in Rotary Engines; and I do hereby 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.

My invention relates to that class of rotary engines which have elliptical pistons rotating within cylindrical casings, the latter being divided by radial sliding partitions or abutments, which are connected with and operated by the piston, and which with the piston divide the cylinder into four compartments, into two of which, diametrically opposite, steam is admitted through diametrically-opposite parts, while the steam used for effecting the previous stroke is exhausted from the other compartments through exhaust-ports, also diametrically opposite each other.

The invention consists in the construction hereinafter described and claimed, and in the means described and claimed for controlling and regulating the admission of steam and for reversing the engine.

In the accompanying drawings, which illustrate my invention, Figure 1 represents an end elevation of my engine with one of the cylinder-heads removed. Figs. 2 and 3 are vertical longitudinal sections on the line 1 1, Fig. 1, looking in opposite directions. Fig. 4 is a vertical longitudinal section showing the engines arranged in pairs. Fig. 5 is a horizontal section through the steam-chest and valves. Fig. 6 is a horizontal section on the plane of the shaft, showing the abutments in full lines. Fig. 7 is a vertical section through the cylinder with the piston and shaft removed.

A designates the cylinder, which is preferably cast in two parts, the line of division being on the plane of the radial partitions or abutments.

B B are the cylinder-heads, which are secured in place by rods or bolts, in the usual manner.

C designates the piston, which is elliptical in cross-section, as indicated in Fig. 1, its greater diameter corresponding with the interior diameter of the cylinder. This piston is fixed upon a central shaft, which has its bearings in the heads of the cylinder.

D is the steam-chest, which is mounted on the top of the cylinder. *d* is a hollow slide-valve within the steam-chest.

E is the shaft of the engine, and *e* is a double-cone-shaped cam mounted on the shaft E, for controlling and operating the valve. The cylinder A is formed with longitudinal passages $a\ a'\ a^2\ a^3$ in its side walls, which passages communicate with the interior of the cylinder at or near its mid-length. It is also formed with passages $a^4\ a^5$ at the top, which passages extend from opposite ends toward the center and open outward near the latter. The cylinder-heads B B′ are formed with passages $b\ b'$, which, when the heads are in place, form continuations of the passages $a^4\ a^5$ in the top of the cylinder. Near the top these passages $b\ b'$ are divided into two branches, those in one head leading to and communicating with the upper passage—say *a*—in one side of the cylinder and with the lower passage, a^2, in the opposite side, and those in the other head with the other passages, $a'\ a^3$.

The steam-chest D is located on the top of cylinder A, and has ports $d'\ d^2$ through the bottom, which parts communicate with the passages $a^4\ a^5$. Within the steam-chest D is a hollow valve, *d*, of a length to cover both the ports $d'\ d^2$, and whose ends are tightly packed.

Between the ports $d'\ d^2$ is the exhaust-port d^3, which communicates with an outlet, d^4, in the top of the cylinder, which outlet may lead either to the open air or to a condenser.

d^5 designates the steam-pipe, which connects with the boiler (not shown) and conveys steam from the latter to the steam-chest.

The valve *d*, as before stated, is hollow to permit the passage of steam therethrough to the steam-port farthest from the steam-pipe d^5 when said port is uncovered, as represented at the left hand of Figs. 4 and 5. When, however, the valve is moved along to cover that port and open the one nearest the steam-pipe, steam is admitted to the latter and shut off from the former. The valve *d* is reduced in size at its central part to form a communicating passage between one or the other of the steam-ports $d\ d'$ (according to the position of

the valve relatively to said ports) and the exhaust-port d^3.

a^6 a^7 designate two sliding gates or abutments, which are located in pockets or chambers in the walls of the cylinder diametrically opposite each other. These gates or abutments are connected with the piston C by inwardly-projecting arms a^8 and pins a^9, which latter project into elliptical grooves or channels a^{10}, formed in the ends of the piston C. Thus when the piston rotates the abutments are reciprocated, their inner edges being held close to the piston to prevent the passage of steam between the parts.

a^{11} designates steam-packing.

The operation of the engine as thus far described is as follows: The parts being in the position as indicated at the left of Figs. 4 and 5, steam is admitted to the steam-chest through steam-pipe d^5, port d', passages a^4 b and a' a^3, and from these latter into the cylinder on opposite sides of the piston and above one of the gates or abutments and below the other. Thus steam-pressure is applied to the piston at points diametrically opposite and to corresponding surfaces, whereby the pressure is equalized.

From the foregoing description it will be understood that when steam is admitted through either of the ports d' or d^2 the other of said ports is in communication with the exhaust-port d^3, and serves as an escape-passage for the steam after the latter has performed its work, steam being admitted to the cylinder through the passages in one cylinder-head and exhausted through those in the other. Steam being then applied on opposite sides of the piston—say through the passages a' a^3—the piston is turned and the pressure is continued until the openings by which the passages a a^2 communicate with the cylinder are passed, when the steam escapes through said openings and passages to the exhaust-port. At this point pressure is entirely removed, to be again applied only after the openings of passages a' a^3 have been passed. The spaces then between the passages a a' and a^2 a^3 constitute the dead-centers of the engine, and in order to overcome these dead-centers I propose to use the engines in pairs, the pistons of the pair being arranged on the same shaft and at right angles to each other, as indicated in full and broken lines in Fig. 1. Thus when one piston is on the dead-center the other is in the most effective position, and carries the first past its dead-point, the two alternately assisting each other.

To reverse the engine, the valve d is shifted to cover the port through which steam was before admitted to the cylinder and to open the port through which steam was before exhausted, whereby steam is admitted to the cylinder through the passages a a^2, and is applied to the piston on opposite sides of the abutments from where it was before applied, thus acting in the opposite direction. The engines being used in pairs, it is necessary that the valves should be shifted and operated simultaneously, and to this end I arrange the parts so that steam is admitted to one cylinder through the port farthest from the steam-pipe d^5 and to the other through that nearest said steam-pipe, whereby said valves are adapted to be moved in the same direction to cut off steam or reverse the direction of motion. As a means for shifting and operating the valves, I employ a movable double cone-shaped cam, e, which is splined on the shaft E and adapted to be moved longitudinally thereon by any of the ordinary shifting mechanisms, which cam acts upon two crank-levers, F F', with which the two valves are respectively connected by valve-stems f f'. (See Fig. 4.) The horizontal arms of the levers F F' stand in the plane of the shaft E, but in opposite directions, and their ends have a bearing on the cam e, the parts being so proportioned that when one arm bears upon the smaller part of its cam the other bears upon the larger part of its cam, whereby the levers are held in an inclined position. When the cam is shifted, the levers are inclined in the opposite direction, whereby the valves are shifted to close the ports a^4 a^4 and to open the ports a^5 a^5, by which the engine will be reversed. By moving the cam the requisite distance both ports may be closed and steam entirely cut off.

In order to hold the levers against the cam, the inner ends of the valves are made larger than the outer ends, and the excess of steam-pressure against the enlarged surfaces of these inner ends tends always to press the valves outward and to hold the levers to the cam, the right-hand valve, as represented in Figs. 4 and 5, being connected to the lever F and the left-hand valve to the lever F'.

f^2 f^3 designate anti-friction wheels which are journaled on the horizontal arms of levers F F'.

e' e^2 designate spiral cams formed in or on the surface of the double cone e. These are for the purpose of effecting a vibration of the levers F F', and a consequent movement of the valves, to wholly or partially shut off steam at any predetermined point in the rotation of the pistons, the object being to permit steam to be used expansively. Inasmuch as the two valves move in the same direction to shut off or let on steam, and inasmuch as the two pistons C of the pair of engines are set at right angles to each other, it is of course necessary that the valves d operate alternately to shut off steam at the proper point in the rotation of each piston, and therefore the highest cam-surfaces of the two cones are arranged in the same radial plane, and the lowest surfaces also in the same radial plane, but at right angles to the high surfaces. Thus, the right-hand valve, Figs. 4 and 5, being operated by the lever F, the highest cam-surface of the cone on which the arm of that lever rests raises the arm and moves the valve forward to close or partially close the steam-port d' of the right-hand cylinders. Now, since the

two pistons are set at right angles to each other, it follows that when steam is shut off from the right-hand cylinder it must be fully on in the left-hand, and since the highest cam-surface of the left-hand cone moves the valve *d* to fully open the port *d'* of the left-hand engine, it is clear that the highest surfaces of the two cones must be in the same radial plane in order to act simultaneously; and the opposite movement of the valves being effected by the low surfaces of the two cones, these also must be arranged in the same radial plane, but at right angles to the high surfaces. By making the cam-surfaces spiral the cones may be moved along in either direction to commence cutting off steam at any desired or predetermined point.

It will of course be understood that steam is to be cut off twice during each revolution of the pistons, and that, therefore, cams e' e^2 are to be arranged on opposite sides of each cone. While I have shown and described the passages a a' a^2 a^3 as extending entirely through the walls of the cylinder from end to end, I desire to have it understood that they are so formed merely for convenience in casting, as it is easier to core entirely through. It is necessary that they extend only to the openings through which they communicate with the interior of the cylinder.

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

1. In a rotary engine, the combination of a cylinder, an induction and an eduction passage leading to and from the cylinder on each side of a diametrical line, an elliptical piston, and a pair of partitions or abutments operated from within the cylinder in both directions directly by the piston to maintain contact therewith, as herein described.

2. The combination of a cylinder or casing having induction and eduction passages in its walls leading from and to a steam-chest through the heads of the cylinder to opposite sides of a diametrical line, an elliptical piston, and a pair of abutments operated to maintain contact with the piston by grooves in the ends thereof, as set forth.

3. In a rotary engine, the combination of a cylinder, an elliptical rotary piston extending entirely across the cylinder, and partitions or abutments within the cylinder operated in both directions to maintain contact with the piston by a coupling between the piston and abutment, as described.

4. The combination, with a divider or abutment operated in both directions by a rotary driver, of an elastic spring-pressed packing strip or stave within the edge of the abutment for compensating for wear and maintaining close contact with the driver, as specified.

5. In a rotary engine, the combination of a valve, a reversing-cone, and connections, substantially as shown and described, for reversing the engine.

6. The combination of a valve, a valve-operating lever, and adjustable conical block connected with the driving shaft for reversing the engine, as specified.

7. The combination of a valve, a valve-operating lever, and a cut-off cam formed on the reversing-cone, as described.

8. The combination of a valve, a valve-operating lever, an adjustable block having a variable cam-surface constituting a variable cut-off, as specified.

9. The combination, in a rotary engine, of a valve and a combined reversing-cone and variable cut-off cam, as specified.

10. In a rotary engine, the combination of a cylinder having induction and eduction ports or passages leading from opposite ends thereof, an elliptical rotary piston, a valve for admitting and cutting off steam, and a conical cam for operating said valve, substantially as described.

11. The combination of two rotary engines connected with the same shaft, the pistons being set at right angles to each other, valves for controlling said engines, and a double cone for operating said valves simultaneously, substantially as described.

12. In a rotary engine, the combination, with the cylinder, of a rotary piston, a valve for controlling admission of steam to said cylinder, and a cone-shaped spiral cam for producing a variable cut-off.

In testimony whereof I affix my signature in presence of two witnesses.

JOSEPH C. JARVIS.

Witnesses:

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GEO. F. DONNELLER.