

(No Model.)

2 Sheets—Sheet 1.

J. V. RICE, Jr.
STEAM ENGINE.

No. 536,393.

Patented Mar. 26, 1895.

Fig. 2.

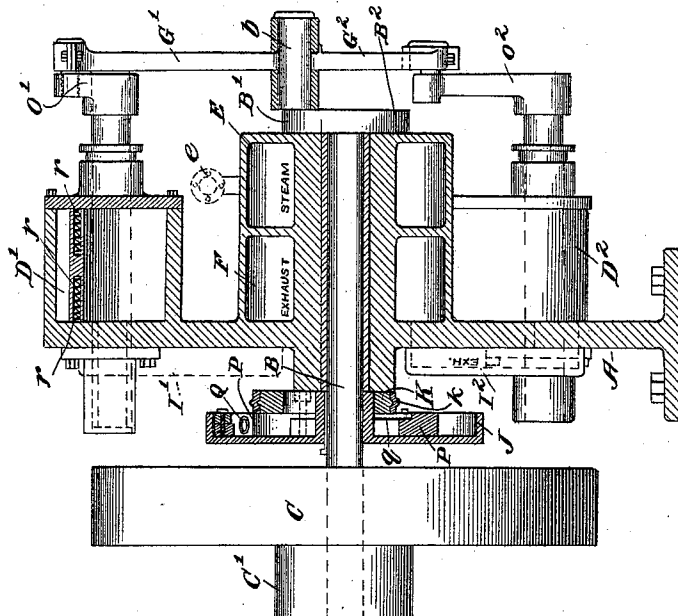
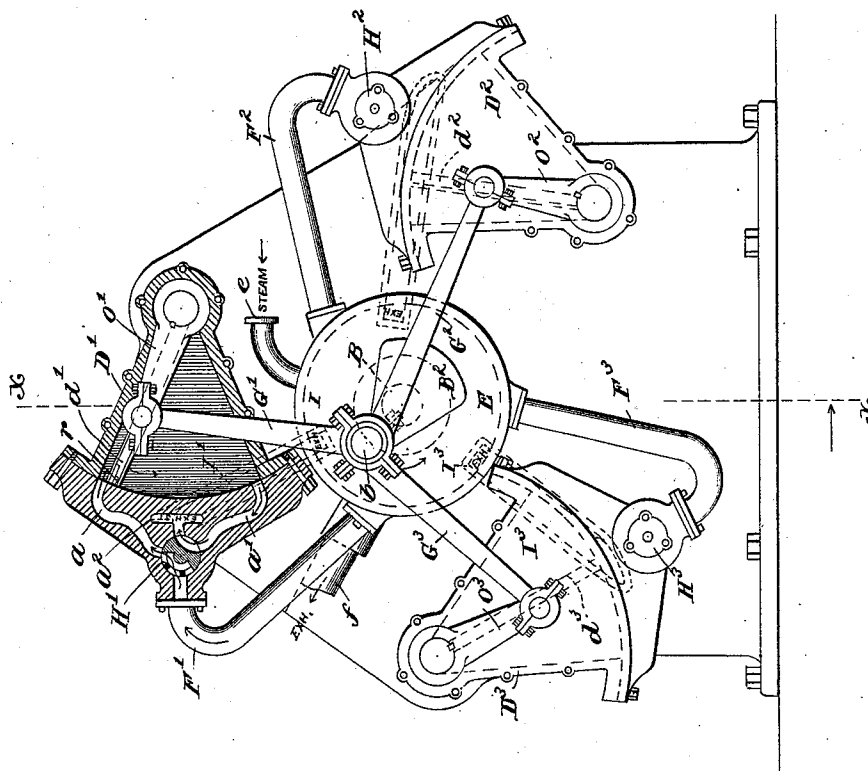


Fig. 1.



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Inventor.
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per Fred B. Barker.
Atty.

(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

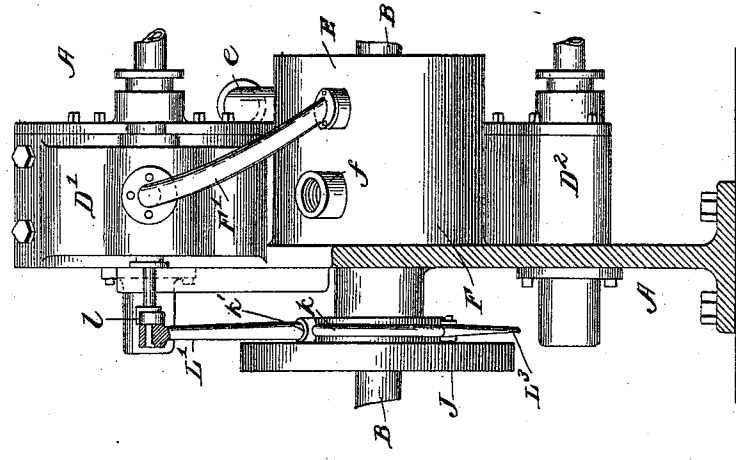
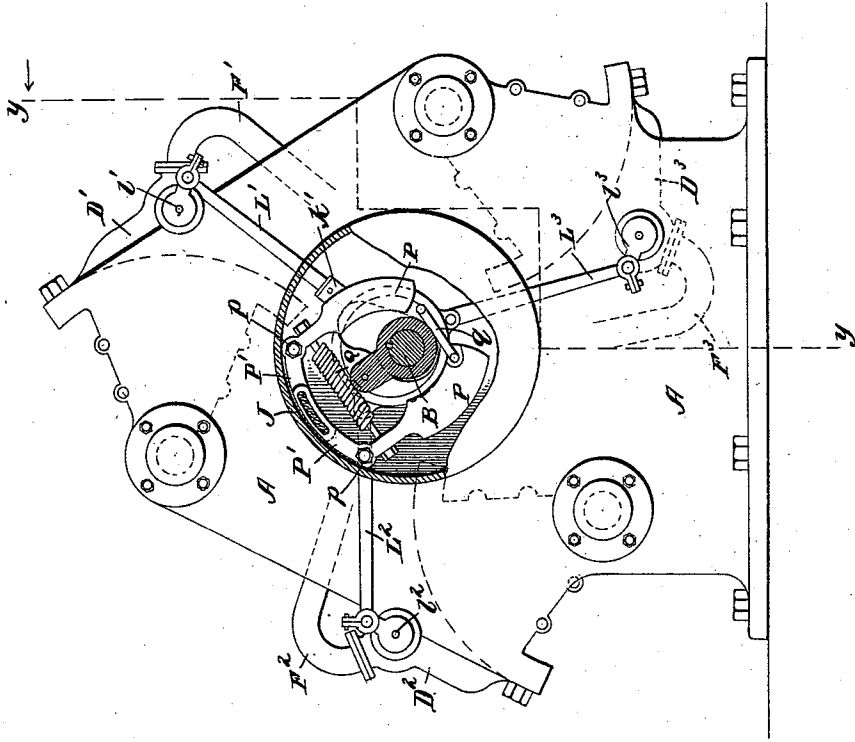


Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN VIRTUE RICE, JR., OF EDGEWATER, NEW JERSEY, ASSIGNOR TO THE
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STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 536,393, dated March 26, 1895.

Application filed January 31, 1895. Serial No. 536,806. (No model.)

To all whom it may concern:

Be it known that I, JOHN VIRTUE RICE, Jr., a citizen of the United States, residing at Edgewater Park, in the county of Burlington and State of New Jersey, have invented certain new and useful Improvements in Steam-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 engines commonly known in the art of steam, as sector-cylinder or oscillating-piston steam engines, the essential feature of engines of this class being a sector-shaped working-chamber in which a rectangular flat piston oscillates to and fro like a shutter or door on its hinge, the axis of oscillation being a rock-shaft on which the piston is fixed.

The object of my invention is to increase the efficiency of engines of this class and make them capable of doing stronger and better work.

The invention consists in the construction, arrangement and combination of the several parts, substantially as will be hereinafter described and then more particularly pointed out in the claims.

In the annexed drawings, illustrating my invention: Figure 1 is a front elevation of my improved engine, one of the sector-cylinders being shown in vertical section. Fig. 2 is a vertical sectional elevation on the line x of Fig. 1. Fig. 3 is a rear elevation of the engine. Fig. 4 is an edge or side elevation in partial section and taken on the line y y of Fig. 3.

Similar letters of reference designate corresponding parts throughout all the different figures of the drawings.

A, designates the main frame of the engine which may vary in size and shape as occasion requires. In the present instance I have constructed it so that it may serve to support three of the working chambers besides the other mechanical parts of the engine, said frame being in this example a vertical or upright structure.

D¹, D² and D³ denote three sector-shaped cylinders for steam or other motive power,

said cylinders or chambers being mounted on or secured to the frame A and situated at suitable distances apart and arranged around a central point where the main shaft is located. I have chosen three chambers as an example simply. There may be more. These sector-cylinders, steam chests, chambers, receptacles, or whatever they may be termed, the name being a matter of indifference, have two radial side-walls which join at one end and radiate therefrom, an outer wall connecting the outer ends of these radial sides, which outer wall represents the fractional portion of a circle, and two end inclosing walls, so that the entire receptacle presents a sectorial-shaped steam chest inclosed by five sides; but it is unnecessary to describe this type of cylinder more minutely than this, as the same is well known.

Within the chest D¹ is a flat oscillating plate or piston d^1 rigidly secured on a rock shaft supported in suitable bearings at the junction of the radial sides of chest D¹. Within chest D², is a similar piston d^2 , and within chest D³ is a similar piston d^3 . It will be understood that the edges of the piston plates d^1 d^2 d^3 may be provided with spring packing devices r r —see Fig. 2—or with any other suitable packing to make the engagement of the edges with the wall of the chest, steam-tight. The intermittent impact of the steam or other motive fluid or liquid alternately against the opposite sides of these pistons vibrates them and by suitable connections which I shall presently describe the power resulting from these vibrations is communicated to the main driving shaft.

B denotes the main shaft which is supported horizontally in main frame A. See Fig. 2. This shaft carries at one end pulley C¹ and wheel C, and at the other end the crank B¹, and the balance weight B². The crank B¹ is provided with the horizontal crank pin b . The rock shaft or journal of piston d^1 is provided on the outside of the chest with a crank arm o^1 , and the connecting rod G¹ connects arm o^1 with crank pin b . The journal of piston d^2 is provided on the outside of its chest with a crank arm o^2 , and a connecting rod G² connects arm o^2 with pin b . The journal of piston d^3 is provided on the outside of its chest

with a crank arm o^3 , and a connecting rod G^3 connects arm o^3 with pin b . In this way all the pistons apply their power to a common central shaft.

5 E denotes a steam-supply chamber. It is of an annular form and surrounds the bearing of engine shaft B. See Fig. 2. This chamber is integral with another similar annular chamber F serving as an exhaust chamber.
10 The two chambers are therefore located alongside of each other, being divided by a suitable partition and chamber E delivers steam to the several chests D' , D^2 , D^3 , while chamber F receives the exhaust steam from said
15 chests. The chamber E is provided with a live steam inlet e , and the chamber F with an exhaust outlet f .

F' F^2 and F^3 designate radially-arranged, steam-supply pipes leading from the annular
20 chamber E to the chests D' , D^2 and D^3 respectively, said pipes in this particular example of my invention being bent as shown to allow them to be situated in the desired manner.

25 I' , I^2 and I^3 denote exhaust ports or passages leading from the chests D' , D^2 and D^3 respectively, to the exhaust chamber F. The curved wall of each of the three chests is provided with a valve that controls the supply
30 and exhaust. H' , H^2 and H^3 denote these valves belonging to the chests D' , D^2 and D^3 respectively. These valves are ordinary plug valves having any suitable construction. They are located at the points where the supply
35 and exhaust passages enter.

Running from the valve toward each of the radial sides of the chest so as to deliver steam on either side of the piston, are the passages a' a^2 . See the section of chest D' in Fig. 1.
40 The valve is not only located between the terminals of the pipes a' a^2 but also between the terminals of the exhaust and inlet passages, as shown in Fig. 1, so that by turning the valve, either of the passages a' a^2 may be put
45 into communication with the steam inlet and likewise either of them may be put into communication with the exhaust. In other words when the valve is in one position it will connect the passage a' with the steam supply so that
50 steam will be conveyed into the chest on one side of the piston, and it will simultaneously connect the passage a^2 with the exhaust, so that the steam in chest on the advancing side of the piston may exhaust through passage a^2 .
55 When the valve has been turned and caused to occupy its other position it will connect passage a^2 with the steam supply and passage a' with the exhaust, thus permitting steam to enter the chest on the other side of the piston
60 and causing a reverse oscillation of the latter.

Mechanism for shifting the valves H' H^2 and H^3 at the end of each stroke so as to insure the proper cut off is now to be described.

65 On the engine shaft B is an eccentric K and this is encircled by the eccentric strap k . J denotes the governor wheel or casing on shaft

B alongside of the eccentric. The plug valves H' H^2 and H^3 are provided outside their seats with crank arms l' l^2 l^3 respectively. These
70 cranks are pivoted to links or connecting rods L' L^2 L^3 respectively, said rods being all connected to the eccentric strap k , the rods L^2 and L^3 being connected pivotally, and the rod L' rigidly. Connecting rod L' supplies
75 the place and function of an ordinary eccentric rod in keeping the eccentric in place. While a pivotal connection therefore is sufficient for rods L^2 and L^3 , it is not for rod L' and therefore the end of the latter is inserted
80 into a socket k' formed on the strap k which socket holds the rods stiff and rigid. It will be therefore obvious that the motion of the eccentric will move the rods L' L^2 and L^3 and thus cause the valves H' H^2 H^3 to be properly
85 shifted at the right time to allow the steam to work in the manner necessary to accomplish the rotation of the engine shaft.

The governor mechanism which is located within the governor wheel J consists essentially of the centrifugally and centripetally
90 acting weights P P pivoted at the ends at p p and provided with the angular arms P' P' which are automatically adjustable on each other by a simple pin and slot connection.
95 The weights P P have also a yielding connection consisting of a spring Q. One of the weights connects by link q with the eccentric. Said eccentric has a slot as shown which allows it to adjust itself on the shaft. Also the
100 hub of wheel J has an arm which is pivoted to the eccentric. When the speed of the shaft becomes too great the weights separate and this shifts the eccentric and tends to partly cut off the steam. This brief description of this governor will be sufficient in this case as I make no claim thereon, *per se*, and reserve the liberty of substituting for this particular governor any other kind that will
105 suit my purpose.

By the multiple arrangement of oscillating pistons around a common shaft, the stoppage of the shaft on a dead center is effectually
110 avoided. Also a very much higher speed and a larger efficiency are attained than are possible with a single oscillating piston or sector-cylinder. All the advantages possessed by this particular type of engine are multiplied in value by my arrangement, and by the provision of the numerous details which
120 combine with the sector-cylinders and their pistons to make a complete engine, I attain many new benefits and provide an engine mechanism which for many purposes is unexcelled by other forms.

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

1. The herein-described multiple sector cylinder engine, consisting in the combination
130 with the central main crank shaft of the engine, of three or more double acting oscillating pistons for applying power to said shaft, arranged around the latter substantially equi-

distant from each other and from the shaft and located in substantially the same vertical plane, each of said pistons having its rock shaft provided with a crank arm, and three
5 or more separate and independent sector-shaped steam cylinders containing said pistons, and connecting rods which connect the main engine shaft with the crank arms of each piston, together with a suitable cut-off
10 mechanism, substantially as described.

2. The herein-described multiple sector cylinder engine, consisting in the combination with the main engine shaft, of three or more double acting oscillating pistons arranged
15 around the latter for applying power thereto, suitable connecting rods between the said pistons and the shaft, a live steam receptacle surrounding and adjacent to the engine shaft and receiving its steam from the steam supply
20 and delivering it through passages to each cylinder, and an exhaust receptacle likewise surrounding and adjacent to the engine shaft and receiving the exhaust from all the cylinders, substantially as described.

3. The herein-described multiple sector cylinder steam engine, consisting in the combination with a central drive shaft of the engine, of three or more double acting oscillating pistons for applying power to said shaft, arranged
30 around the latter substantially equidistant from each other and from the shaft and located in substantially the same vertical plane, each of said pistons having its rock shaft provided with a crank arm, connecting rods which
35 connect the main shaft with the crank arms of each piston, a steam receptacle surrounding and adjacent to the engine shaft which receives its steam from the steam supply, conduits or pipes leading from this receptacle to
40 each of the cylinders, an exhaust receptacle surrounding and adjacent to the engine shaft that receives the exhaust steam from the cylinders, valves in each cylinder that control the steam supply as well as the exhaust, and
45 automatically operating cut-off mechanism between these valves and the main shaft, substantially as described.

4. In an engine, the combination of frame A, cylinders $D' D^2 D^3$, pistons $d' d^2 d^3$ therein, shaft B having crank B' , connecting rods $G' G^2 G^3$, steam chamber E and exhaust chamber F, pipes $F' F^2 F^3$ leading from chamber E to the cylinders and exhaust passages $I' I^2 I^3$ leading from the cylinders to the exhaust
55 chamber F, substantially as described.

5. In an engine, the combination of cylinders $D' D^2 D^3$ pistons $d' d^2 d^3$ therein having rock shafts provided with arms $o' o^2 o^3$, shaft B and the connecting rods between its crank
60 and said arms, chambers E and F, pipes $F' F^2 F^3$ leading from chamber E to the cylinders, passages $I' I^2 I^3$ leading from cylinders to chamber F, plug valves $H' H^2 H^3$ having arms $l' l^2 l^3$, eccentric K having strap k and rods
65 $L' L^2 L^3$, and a governor, all arranged to operate substantially as described.

6. In a steam engine, the combination of a

series of oscillating pistons and their sector-shaped cylinders, all arranged so as to be double acting and each piston having its rock
70 shaft provided with a crank arm, the driving shaft of the engine, the connecting rods between the piston arms and the driving shaft, an annular steam receptacle surrounding and adjacent to the shaft, pipes or conduits lead-
75 ing from said receptacle to each cylinder, an annular exhaust receptacle likewise surrounding and adjacent to the main shaft, passages leading from the cylinders to said receptacle, valves in each cylinder, controlling the sup-
80 ply and exhaust, eccentric links connected thereto, the eccentric and a governor, substantially as described.

7. The herein-described sector cylinder engine, consisting in the combination with a
85 central shaft, of three or more double-acting oscillating pistons for applying power to said shaft, arranged around the latter substantially equidistant from each other and from the shaft and located in substantially the same
90 vertical plane, each of said pistons having its rock shaft provided with a crank arm, three or more sector-shaped steam cylinders containing said pistons, connecting rods which connect the main shaft with the crank arm of
95 each piston, plug valves located in each cylinder and having arms, rods attached to these arms and operated by the main shaft for the purpose of providing an automatic cut-off, an
100 annular steam receptacle surrounding and adjacent to the main driving shaft, an annular exhaust receptacle likewise surrounding and adjacent to the main shaft, and passages leading from the steam and exhaust receptacles to the several cylinders, substantially as de-
105 scribed.

8. The herein-described multiple sector cylinder engine, consisting in the combination with the main central engine shaft, of three or more double-acting oscillating pistons for
110 applying power to said shaft, arranged around the latter substantially equidistant from each other and from the shaft, three or more separate and independent sector-shaped steam cylinders containing said pistons, suitable
115 connecting rods which connect the main shaft with the crank arms of each piston, valves arranged in the several cylinders for controlling the supply and exhaust of the steam for each side of the piston, rods connected to said
120 valves and operated automatically by the main shaft so that the cut-off may be automatic, a steam receptacle surrounding and adjacent to the main shaft, pipes running from said receptacle to the several cylinders,
125 an exhaust receptacle likewise surrounding and adjacent to the main shaft, pipes leading from said exhaust receptacle to the several cylinders, all substantially as described.

9. In an engine, the combination with the
130 main engine shaft, of a series of three or more sector shaped cylinders, arranged around the shaft, said cylinders being separate and independent from each other and each having its

own inclosing casing or wall, provided with
ports, passages and a valve, a series of double
acting oscillating pistons located in said cyl-
inders so as to receive steam alternately on
5 their opposite sides, connecting rods between
said pistons and the shaft for applying power
to the latter, a live steam receptacle adjacent
to the shaft and receiving its steam from the
steam supply, steam pipes leading from said
10 receptacle to the several cylinders, an exhaust

receptacle likewise adjacent to the engine
shaft, and exhaust pipes leading from the
several cylinders to the said receptacle, sub-
stantially as described.

In testimony whereof I affix my signature 15
in presence of two witnesses.

JOHN VIRTUE RICE, JR.

Witnesses:

THEO. BRASINGTON,
ALICE A. EVANS.