(No Model.)

3 Sheets—Sheet 1.

J. A. REARDON.

STEAM ENGINE.

No. 604,415. Patented May 24, 1898.

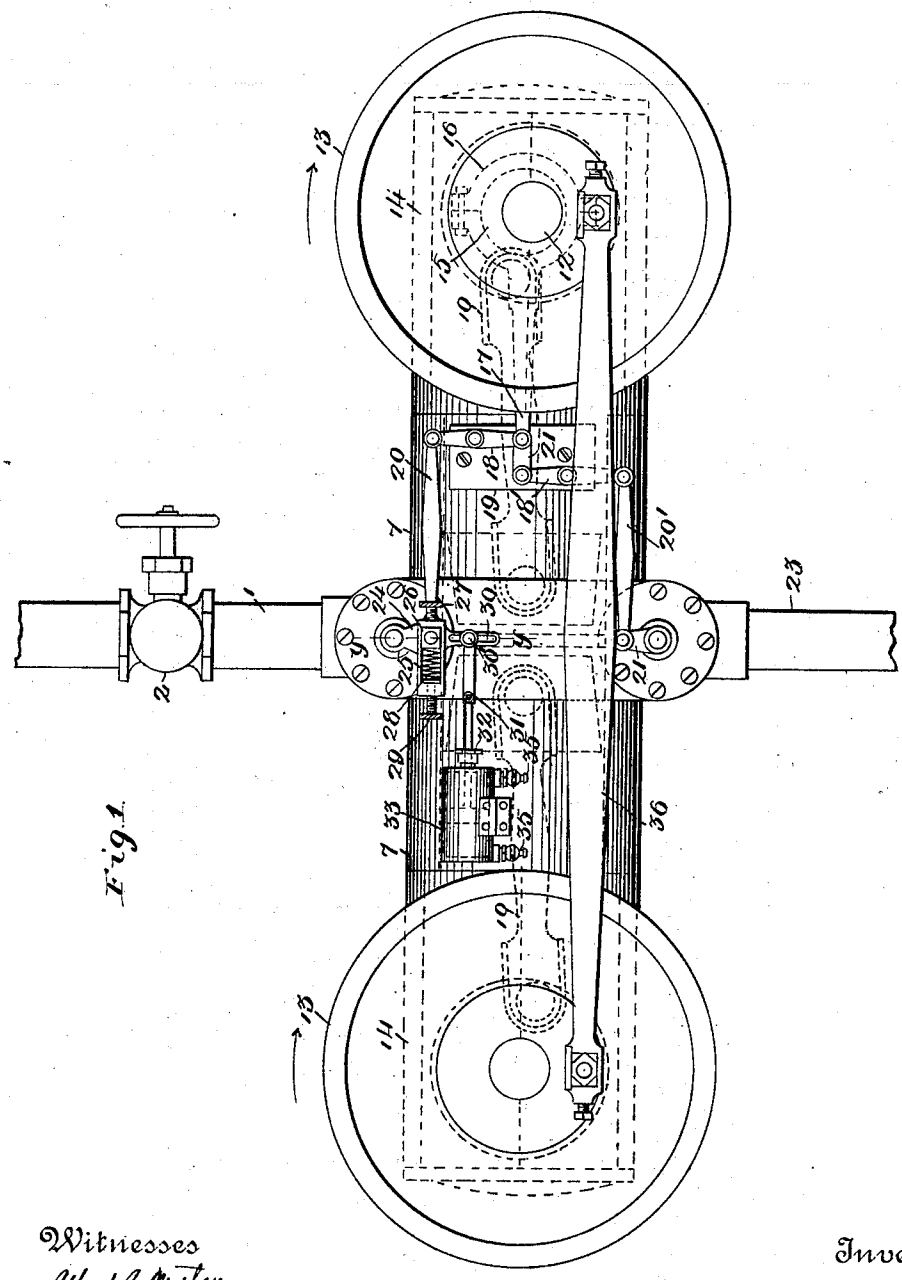

Fig. 1.

Witnesses
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(No Model.)

3 Sheets—Sheet 2.

J. A. REARDON.

STEAM ENGINE.

No. 604,415. Patented May 24, 1898.

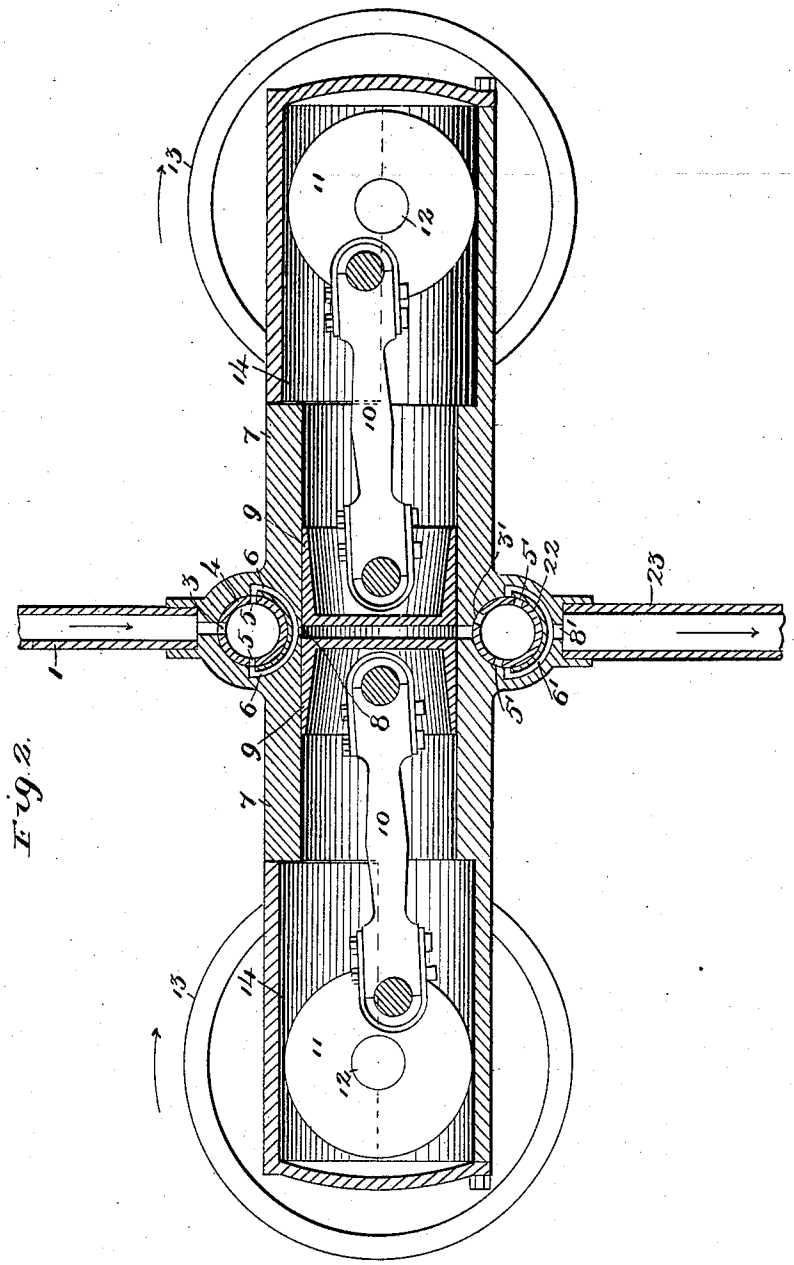

Fig. 2.

Witnesses
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(No Model.)

3 Sheets—Sheet 3.

J. A. REARDON.

STEAM ENGINE.

No. 604,415. Patented May 24, 1898.

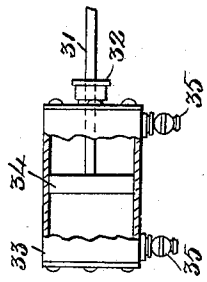

Fig. 5.

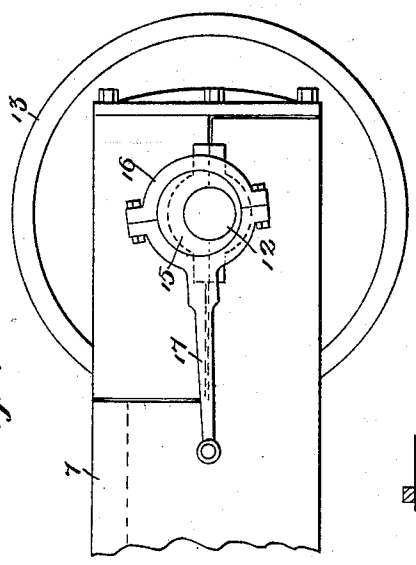

Fig. 4.

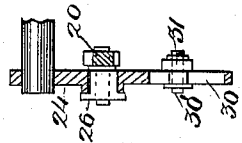

Fig. 6.

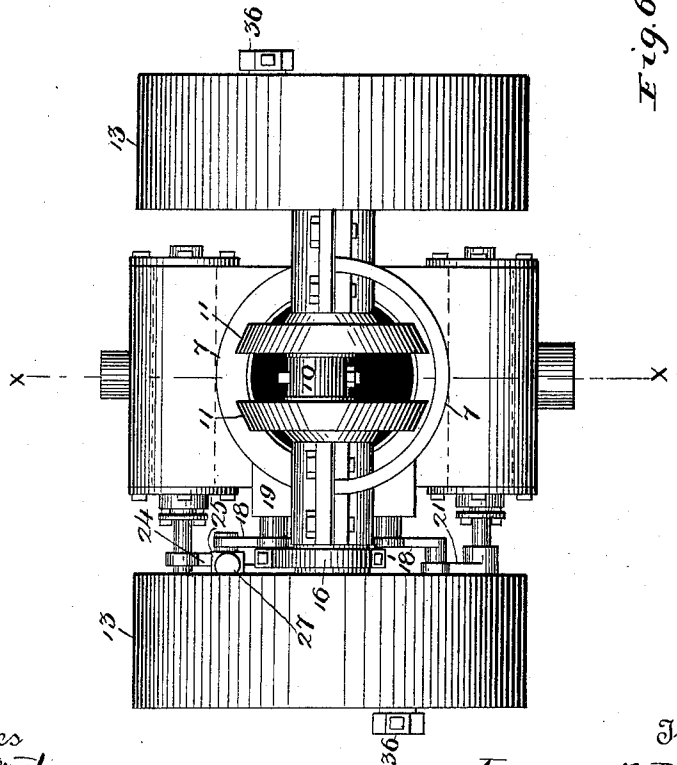

Fig. 3.

Witnesses
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UNITED STATES PATENT OFFICE.

JAMES A. REARDON, OF ST. LOUIS, MISSOURI, ASSIGNOR OF TWO-THIRDS TO JAMES H. BUTTERELL AND PETER HESSEL, OF SAME PLACE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 604,415, dated May 24, 1898.

Application filed April 8, 1897. Serial No. 631,300. (No model.)

To all whom it may concern:

Be it known that I, JAMES A. REARDON, a citizen of the United States, residing at St. Louis, State of Missouri, have invented certain new and useful Improvements in Steam-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part thereof.

My invention has relation to improvements in steam-engines; and it consists in the novel arrangement and combination of parts more fully set forth in the specification and pointed out in the claims.

In the drawings, Figure 1 is a side elevation of the engine. Fig. 2 is a longitudinal section on line *x x* of Fig. 3. Fig. 3 is an end view of the engine. Fig. 4 is a side elevation of one end with the driving-pulley removed. Fig. 5 is a detail of the supplemental air-cylinder, partly broken away; and Fig. 6 is a section on line *y y* of Fig. 1.

The object of my invention is to construct a double-acting high-speed engine which will be compact, one whose operating parts shall be so well balanced as to insure freedom from vibration, one in which the cut-off is under ready control of the engineer, the adjustments being readily effected from the outside of the engine, one whose speed can be adjusted with great nicety, one which will combine simplicity of construction with a high degree of efficiency, one which embodies a minimum number of parts, one which will economize steam, one in which the water of condensation does not interfere with the running of the engine, one in which the valves are thoroughly balanced, and one presenting further and other advantages better apparent from a detailed description of the engine, which is as follows:

Referring to the drawings, 1 represents the steam-inlet pipe, provided with the usual throttle-valve 2, the base of the pipe communicating through a valve-port 3 with the interior of an oscillating substantially cylindrical steam-valve 4, provided with diametrically-located exit-ports 5 5, which communicate with a semicircular passage 6, formed in the walls of the cylinder 7, a port 8 leading from the base of said passage to the interior of the cylinder and into the space formed between the adjacent ends of the oppositely-reciprocating pistons 9, with which said cylinder is provided. Each piston is connected by a pitman 10 to a crank-disk or arm 11, mounted at the center of a sectional drive-shaft 12, whose opposite ends are provided with a driving-pulley 13. Each crank-disk is mounted or housed in a boxing 14, cast with or secured to the cylinder, by which arrangement the several parts are protected against access of dirt and dust. Carried by one section of the shaft 12 at one end of the engine is an eccentric disk 15, which is loosely embraced by a sectional eccentric ring 16, with one of the sections of which is formed integrally an arm 17, whose farther or opposite end is pivotally secured to one arm of an oscillating lever 18, pivoted along the outer plane surface of a casing or bracket 19, carried by the cylinder-walls, the opposite arm of the said lever 18 being pivotally secured to one end of a link 20. Pivotally secured, also, to the farther end of the arm 17 is a short link, whose opposite end is pivotally connected to the end of one arm of an oscillating lever 18′, the opposite end or arm of the latter being pivotally connected to one end of a link 20′. The opposite end of the link 20′ is secured to the free end of an arm 21, connected to the oscillating exhaust-valve 22 and located on the outside of the casing of the latter. Like the valve 4 the valve 22 is provided with ports 3′ 5′ 5′, the former communicating with the cylinder and the latter with a passage 6′. The passage 6′ communicates by a port 8′ with the exhaust-pipe 23. Of course, and as will presently appear, the valves are so set that as steam is being admitted by the valve 4 into the cylinder the exhaust-valve shuts off communication between the cylinder and the pipe 23, and vice versa. While steam is exhausting, no live steam is admitted, it being understood that the pistons, which are driven apart by the action of the live steam, return to their normal positions, as seen in Fig. 2, both by the momentum of the parts and by the removal of pressure from the cylinder incident to the exhaust.

The outer projecting end of the axis of oscillation or trunnion of the steam-valve 4 is

provided with an arm 24, from whose approximately medial portion there projects at right angles to the arm proper a slotted arm or guideway 25, adapted to receive and guide a block 26, to which the adjacent end of the connecting-link 20 is pivotally secured. Adapted to bear against one end of the block is the inner end of a controlling-screw 27, passed through the terminal wall of the guideway. Against the opposite face of the block is adapted to bear a coiled spring 28, confined within the guideway, the tension of the said spring being adjusted by a screw 29. The lower end of the arm 24 is provided with a longitudinal slit 30, within which is adapted to be adjusted the outer end of a jointed piston-rod 31, the connection being effected by a pin 30′, passing through the slit, the pin being provided with a washer at its opposite end, as best seen in Fig. 6, the inner end of the piston-rod operating through a stuffing-box 32 of a supplemental air-cylinder 33, the said piston-rod controlling and operating a piston 34 within said cylinder. The peripheral wall of the air-cylinder is provided at each end with an air cock or valve 35, which by screwing to the proper degree regulates and controls to a nicety the admission into and escape of air from the cylinder during the reciprocation of the piston. The pulleys 13 on each side of the engine are connected by a connecting-rod 36.

Upon the admission of live steam into the space between the pistons 9 the latter are forced apart, imparting rotation to the pulleys in the direction indicated by the arrows, the valves 4 and 22 being oscillated simultaneously in the same direction by reason of the link connections already described, the valve 4 admitting steam into the steam-cylinder for the forcing of the pistons apart and the valve 22 permitting the exhaust of the steam as the pistons are brought together by the momentum of the engine. From the foregoing description the connection between the oscillating arm 24 of the valve 4 and the connecting-link 20 is effected through the medium of the block 26, secured to said link, and through the spring 28, confined within the lateral guideway 25, forming a part of said arm. The connection between the arm 24 and the link 20, therefore, is a yielding one, the spring 28, however, being sufficiently stiff and offering sufficient resistance to the link 20 to enable the latter to oscillate the arm 24 in one direction by pressing against the spring and to oscillate it in the reverse direction by drawing on the block confined within the guideway. The tension of the spring is preserved and maintained to the required degree by an adjusting-screw 29. It is apparent, however, by an inspection, for example, of Fig. 1, that by forcing the controlling-screw 27 against the block 26 the effect would be (inasmuch as the block is relatively stationary by reason of its connection to the link 20) to draw the guideway 25 along the block, (to the right in said Fig. 1,) thereby slightly tilting or rocking to the right the arm 24, of which the guideway forms a part, and thus shifting the position of the steam-valve, to which the arm 24 is secured relatively to the passage 6, with which the ports of said valve communicate. By thus slightly rocking the steam-valve from its normal position the time of cut-off is regulated.

By reason of the slotted connection between the outer end of the piston-rod 31 and the lower end of the arm 24 it is apparent that the piston-rod may be adjusted for lengthening or shortening the stroke of the piston 34 in the air-cylinder 33. By regulating the openings controlled by the cocks 35 on either side of the piston 34 and through which the air can either discharge or reënter during the reciprocation of the piston the operator can regulate the resistance which said piston offers to the free oscillation of the arm 24, and hence regulate the speed of the engine, it being understood, of course, that upon the rapidity of oscillation of the arm 24 depends the rapidity of oscillation of the steam-valve 4. At the same time the regulating of the pressure of air in the cylinder 33 through the medium of the cocks 35 thereof, causes the block 26 to press back the spring 28, thereby resulting in a shortening of the stroke of the slide-valve. The spring 28 will under all circumstances take up any jar incident to the action of the parts with which the arm 24 is associated. The arm 21 is not provided herein with any controlling mechanism, inasmuch as it is desirable that the valve 22 shall exhaust freely into the atmosphere at the proper time to prevent any back pressure; but it is within the spirit of this invention to so provide said valve with a similar controlling device.

It is apparent that by the use of two pistons in one cylinder at all times reciprocating in opposite directions the parts of the engine will be thoroughly balanced, and the horizontal disposition of the engine, as here illustrated, is not necessary, as it would operate if set up on end or vertically.

So far as the action of the supplemental air-cylinder is concerned it may be stated that during the reciprocation of the piston 34 the same resistance is offered thereto with each stroke thereof, inasmuch as the cocks or valves 35 are each adjusted to offer equal passages to the influx of air into and the efflux of air from the cylinder. This resistance is constant for any predetermined speed of the engine, although it can be varied for different speeds by varying the sizes of the air-openings controlled by the cocks 35. It may be added, too, that yielding connection between the link 20 and the spring 28, against which the link bears when moving in one direction, as previously stated in the specification, does not materially affect the constancy of this resistance for each reciprocation of said piston, inasmuch as the spring 28 is sufficiently

stiff to render the latter practically unyielding to the resistance offered by the air in the supplemental cylinder under the ordinary operations of the engine, the spring being, however, sufficiently yielding to allow for the necessary compression or expansion thereof (under the action of the controlling-screw 27) to set the rock-valve for any predetermined point of cut-off.

Having described my invention, what I claim is—

1. In a steam-engine, a suitable cylinder, a steam-pipe communicating therewith, a valve-casing at the juncture of the pipe with the cylinder-wall, a rock-valve in said casing, a piston for the cylinder, a drive-shaft, a crank-disk carried by the shaft, a pitman connecting the disk with the piston, an arm carried by the valve and disposed along the outside of the casing, intermediate yielding connections between said arm and drive-shaft for regulating the point of cut-off for said valve, rigid connections between the said arm and drive-shaft in connection with the said yielding connections for rocking the valve during the reciprocation of the piston, a supplemental air-cylinder, a piston for said cylinder, air-regulating cocks carried by the cylinder-walls on either side of the piston for offering predetermined resistance to the reciprocation of the piston of said supplemental cylinder, and suitable connections between the rock-valve and the piston of the supplemental cylinder, substantially as set forth.

2. In a steam-engine, a suitable cylinder, a steam-pipe communicating therewith, a valve-casing at the juncture of the pipe with the cylinder-wall, a rock-valve in said casing, a piston for the cylinder, a drive-shaft, a crank-disk or arm carried by the shaft, a pitman connecting the disk with the piston, an arm carried by the valve and disposed along the outside of the casing thereof, intermediate connections between said arm and the drive-shaft for rocking the valve during the reciprocation of the piston, a supplemental air-cylinder, a piston therefor, intermediate connections between said piston and rock-valve, and suitable valve-controlled openings disposed on the cylinder-walls for offering a predetermined resistance to the reciprocation of the piston of the supplemental air-cylinder and to the oscillation of the rock-valve, whereby the speed of the engine is controlled, substantially as set forth.

3. In a steam-engine, a cylinder, a steam-pipe leading thereinto, a piston reciprocating within the cylinder, a drive-shaft, an exhaust-pipe leading from the cylinder, a valve controlling the steam-pipe and a similar valve controlling the exhaust-pipe, an arm carried by each valve along the outside of the casing thereof, an eccentric controlled arm in connection with the drive-shaft, suitable link connections between the arm and the arm carried by the exhaust-valve, an oscillating lever having one end pivotally secured to the eccentric controlled arm, a link pivotally connected to the end of the opposite arm of the oscillating lever, a lateral extension or guideway forming a part of the arm carried by the steam-valve, a block mounted in said guideway and pivotally secured to the opposite end of the link, a controlling-screw for said block, a spring confined within the guideway and bearing against the opposite face of the block whereby a yielding connection is formed between the link and the steam-valve, an adjusting-screw for the spring, a supplemental air-cylinder carried by the engine, a piston and piston-rod therefor, a slotted connection between the outer end of the piston-rod and the arm secured to the steam-valve, air cocks or valves disposed at each end of the air-cylinder to offer any predetermined resistance to the reciprocation of the piston therein, the parts operating substantially as and for the purpose set forth.

4. In a steam-engine, a suitable cylinder, a steam-pipe communicating therewith, a valve-casing at the juncture of the pipe with the cylinder-wall, a rock balance-valve in said casing, two oppositely-reciprocating pistons in said cylinder, a drive-shaft for each piston, a crank-disk carried by each shaft, a pitman connecting each disk with its corresponding piston, an arm carried by the valve and disposed along the outside of the casing, intermediate rigid and yielding connections between said arm and one of the drive-shafts adjacent thereto for rocking the valve during the reciprocation of the piston and for setting the point of cut-off for said valve, a driving-pulley for each drive-shaft, and a connecting-rod connecting the pulleys, whereby the same speed is imparted to both drive-shafts simultaneously, substantially as set forth.

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

JAMES A. REARDON.

Witnesses:

EMIL STAREK,

A. J. ZIMMERMAN.