(No Model.)

2 Sheets—Sheet 1.

R. CREUZBAUR.

STEAM ENGINE.

No. 332,500. Patented Dec. 15, 1885.

Fig: 3.

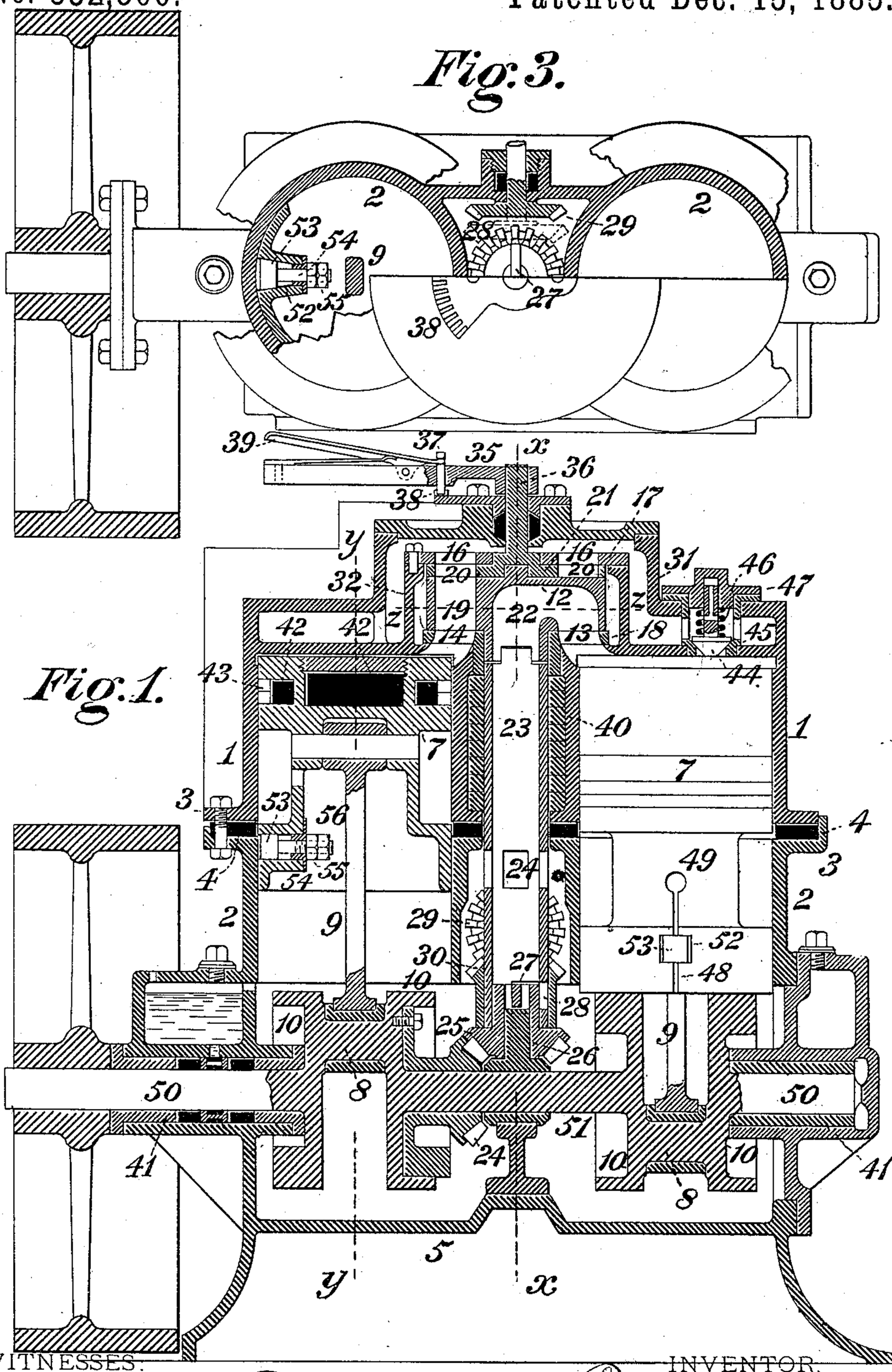

Fig: 1.

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(No Model.) 2 Sheets—Sheet 2.

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STEAM ENGINE.

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Fig: 2.

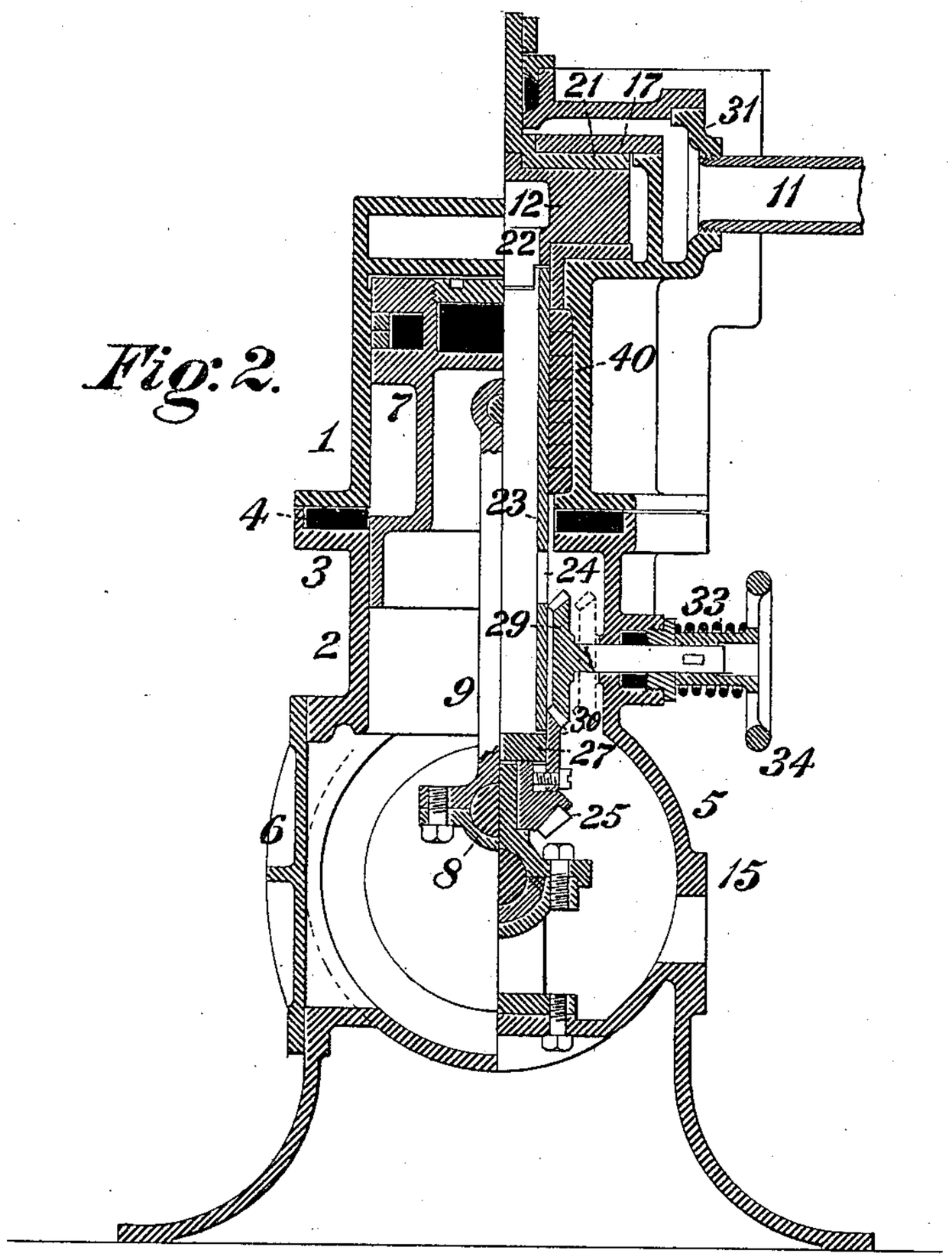


Fig: 4.

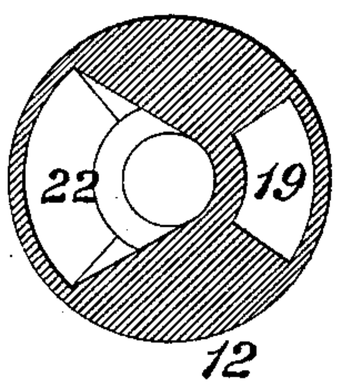
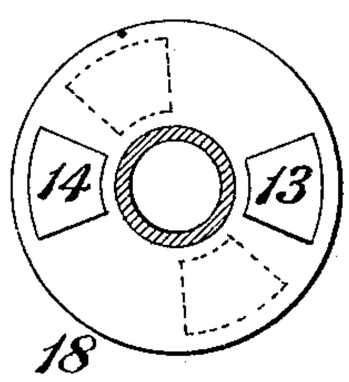


Fig: 5.



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STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 332,500, dated December 15, 1885.

Application filed August 31, 1885. Serial No. 175,718. (No model.)

To all whom it may concern:

Be it known that I, ROBERT CREUZBAUR, residing at Brooklyn, in the county of Kings and State of New York, a citizen of the United States, have invented or discovered certain new and useful Improvements in Steam-Engines, of which improvements the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1 is a vertical longitudinal central section through a steam-engine embodying my invention; Fig. 2, a vertical transverse section, the right-hand half being taken at the line *x x* of Fig. 1, and the left-hand half at the line *y y* of same figure; Fig. 3, a plan view, partly in section; Fig. 4, a horizontal section, looking downward, through the main valve at the line *z z* of Fig. 1, and Fig. 5 a plan view of the valve-seat.

My invention relates to steam-engines of the single-acting type having two or more cylinders located side and side—that is, in parallel planes at right angles to a common crank-shaft—and its objects are to provide novel and improved means for effecting distribution by a balanced rotating valve, utilizing steam expansively by an independent cut-off plate operating in connection with the main valve, regulating the degree of expansion automatically or by hand, actuating the cut-off valve through gearing from the crank-shaft, exhausting steam centrally from the valve through its driving-shaft and carrying the exhaust-steam into a closed crank-case, reversing the direction of movement of the engine through gearing acting on the valve, preventing cylinder condensation by dividing the cylinders into higher and lower temperature sections separated by heat-intercepting packing, insulating the ends of the pistons by heat-intercepting packing, and operating the piston ends of lower-temperature sections of the cylinders, separating the exhaust-passage from the higher-temperature sections of the cylinders by heat-intercepting packing, providing the cylinder-heads with a steam-jacket, through which steam from the boiler circulates in its passage to the main valve, and relieving excess of pressure in the cylinders by providing for the escape of steam therefrom into the steam-jacket when required.

The improvements claimed are hereinafter fully set forth.

In the practice of my invention I provide two or more single-acting cylinders, each composed of an upper higher-temperature section, 1, and a lower lower-temperature section, 2, which sections are bored out to substantially equal diameters, and are firmly secured together by bolts passing through flanges 3, between which is interposed a heat-intercepting packing, 4, of any suitable material which is substantially a non-conductor of heat. The cylinders are located side and side—that is to say, with their axes in parallel planes—and are secured to the top of a closed crank case or chamber, 5, having end bearings, 41, for the journals 50 of a crank-shaft, 51, which is mounted in said bearings at right angles to the axes of the cylinders. Access to the interior of the crank-case is permitted by a removable head or bonnet, 6, closing an opening in one of its sides, and suitable lateral and end flanges are formed upon the lower side of the case, through which it may be secured upon the foundation on which the engine rests when in operation. Each cylinder is open at its lower end, and is fitted with a long piston, 7, of the trunk class, and said pistons are coupled, by connecting-rods 9 9, with crank-pins 8 8, which are set opposite one to the other, or one hundred and eighty degrees apart, upon a pair of double cranks, 10 10, formed upon the crank-shaft 51. Steam from the boiler is supplied through a steam-pipe, 11, to a steam-jacket, 31, which covers the heads of the upper sections, 1, of the cylinders and incloses a valve case or chest, 32, located above and centrally between the cylinders. The steam from the jacket enters the valve-case through supply-ports 16 in a pressure-relieving plate, 17, which is fixed to and closes the top of the valve-case, said ports corresponding in position and dimensions with cylinder-ports 13 14, formed in the valve-seat 18, and leading therefrom into the upper ends of the cylinders. The admission of steam to and its exhaust from the cylinders is effected by a disk or block main

or distribution-valve 12, adapted to be rotated, as presently to be described, upon the valve-seat 18, and fitting between the same and an adjustable cut-off plate, 21, said cut-off plate fitting between the top of the valve and the pressure-relieving plate 17, and having cut-off ports 20, communicating with the supply-ports 16 thereof. In the rotation of the valve 12 steam passing through the ports 16 and 20 is supplied alternately to the cylinder-ports 13 and 14 through a steam-port, 19, in the valve, and is exhausted from the cylinders through an exhaust-port, 22, in the valve, to the interior of a tubular spindle or sleeve, 23, with which the valve is connected by projections entering recesses in the end of the spindle, in the manner of a clutch-coupling, and through which the valve is rotated by gearing from the crank-shaft. The exhaust-steam escapes through openings 24 in the spindle into the crank-case, serving to lubricate the crank-pins and cylinders, and is finally discharged through an exhaust-pipe connected to a flange or nozzle, 15, on the crank-case. It will be seen that the main valve 12, while rotating in unison with its driving-spindle 23, is, by reason of its clutch connection therewith, free to adjust itself to its seat 18. The steam-port 19 of the valve is arranged to have a lead of one-twentieth of the port's path, and when not acted upon by the cut-off plate to cut-off the steam at about two-thirds of the stroke of the pistons. The exhaust-port 22 of the main valve leads two-elevenths of the diameter of the port's path and closes at three-quarters of the stroke. If the cut-off ports 20 are made five-sixths of the diameter of the cylinder-ports 13 14, the shortest cut-off will be at one-tenth of the stroke, and the steam cannot be admitted during more than seven-twelfths of the stroke without following with the cut-off plate a distance equal to the difference between the diameter of the cut-off ports and the cylinder-ports. By making the cut-off ports equal in diameter to the cylinder-ports the steam may be made to follow the pistons during two-thirds of the stroke, and the shortest cut-off will be at one-seventh of the stroke. The valve having equal dead spaces between the steam and exhaust ports operates similarly in both directions. The provision of the steam-jacket around the valve-casing causes the latter to expand equally with the main valve and cut-off plate, so that these remain equally tight and equally free for movement at any degree of temperature of the steam. The plate 17, in addition to performing its prime function of relieving pressure upon the main and cut-off valves, greatly reduces leakage at the peripheries of the working-surfaces thereof by excluding live steam from direct contact therewith.

Rotation is imparted to the tubular spindle 23 and connected main valve 12 through a bevel-gear, 24, fixed upon the crank-shaft and engaging a similar gear, 25, which is mounted to rotate freely upon a fixed supporting-spindle, 26, and to turn freely within the spindle 23 within a circumferential range limited by a key, 27, passing through the hub of the gear 25, and engaging by its ends stops or shoulders at the ends of a segmental slot, 28, in the spindle 23.

Reversal of the movement of the engine is effected by turning the spindle and main valve independently of the gear 25 by a reversing bevel-gear, 29 29, journaled in the crank-case, and having the capacity of end-play in its bearings, so as, when moved inwardly, to engage a corresponding gear, 30, fixed upon the valve-driving spindle 23. The reversing bevel-gear 29 stands normally in the position shown in full lines in Fig. 3 and in dotted lines in Fig. 2, and is maintained in such position by a spring, 33, bearing against a hand-operating wheel, 34, on the outer end of the stem of the gear 29, and against a fixed abutment. The tension of the spring 33 being overcome by hand-pressure, the gear 29 is caused to engage the gear 30, and the spindle and valve may thereby be turned into position to reverse the direction of movement of the shaft, to do which will require about one-fourth of a revolution when the pistons stand at half-stroke. If preferred, the spring 33 and the end-play of the reversing-gear may be dispensed with and the latter may remain continuously engaged with the gear of the valve-spindle.

Where material variations recur in the duty imposed on the engine, the cut-off plate 21 may be controlled automatically by a governor in the usual manner; but for ordinary service the cut-off plate is adjusted by hand through a hand-lever, 35, keyed to the stem 36 of the cut-off plate. The lever 35 carries a sliding bolt, 37, engaging any of a series of teeth in a fixed rack, 38, from which it is released as required to admit of the movement of the hand-lever and cut-off plate by the depression of a spring-lever, 39, fulcrumed on the hand-lever and coupled to the sliding bolt. The range of the bolt along the fixed rack corresponds with the allowable movement of the cut-off ports; or check-lugs may be fixed to the rack to prevent an excess of traverse of the bolt.

The steam delivered from the boiler to the jacket fills the same and surrounds the valve-case, and when distributed into the cylinders is protected against undue condensation by the heat-intercepting packing 4, which separates their higher-temperature sections 1, which are to be filled with steam, from their lower-temperature sections, 2, which inclose the pistons at the ends of their downward strokes by similar packing, 40, surrounding the valve-spindle 23, and protecting the cylinders from the cooling action of the exhaust-steam passing through the same, and by similar packing, 42, inserted in the pistons 7, behind their packing-rings 43 and adjacent to their heads, the steam-jacket further assisting in preventing cylinder condensation. To admit of the relief of excess of pressure in the

cylinders, relief-valves 44 are seated in castings 45, over openings in their heads leading into the steam-jacket 31, and are held in position by springs 46, bearing against the valves and against the bonnets 47 of their casings.

Wear, if any, at the steam ends of the pistons can be provided for by maintaining sufficient outward pressure of their packing-rings 43, and to compensate wear of their lower ends they are longitudinally split or divided by vertical slots 48, extending upwardly from their lower ends and terminating in rounded openings 49, said slots having laterally-tapered recesses 52, in which are fitted correspondingly-tapered blocks 53, provided with threaded shanks 54. By screwing up nuts 55, engaging the threads of the shanks 54 and bearing against plates 56, fitting over the inner ends of the recesses, the blocks may be drawn inwardly, and by their wedging action against the sides of the recesses 52 will effect the expansion of the pistons requisite to take up the wear thereof. The slots 48 are located vertically above the center of the shaft, as shown in the left-hand cylinder, Fig. 1, and not on the side of the piston, as represented, for convenience of illustration in the right-hand cylinder.

The means above described for taking up wear of the lower ends of the pistons and the employment of heat-intercepting packing in the pistons are not herein claimed, as the same will constitute the subject-matter of a separate application or applications for Letters Patent to be filed by me in due time.

I claim herein as my invention—

1. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a main or distribution valve governing the supply and exhaust of steam to and from said cylinders, a stationary pressure-relieving plate interposed between the back of the valve and its source of steam-supply, and a steam-jacket surrounding the valve-casing and outer side of the pressure-relieving plate, substantially as set forth.

2. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a rotating main or distribution valve governing the supply and exhaust of steam to and from said cylinders, an adjustable cut-off plate located on the back of the main valve, a stationary pressure-relieving plate located on the back of the cut-off plate, and a steam-jacket surrounding the valve-casing and outer side of the pressure relieving plate, substantially as set forth.

3. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a rotating main or distribution valve governing the supply and exhaust of steam to and from said cylinders, an adjustable cut-off plate located on the back of the main valve, a stationary pressure-relieving plate located on the back of the cut-off plate, a hand-lever fixed to a stem which is secured to the cut-off plate and passes freely through the pressure-relieving plate, a sliding bolt fitting in said hand-lever and engaging teeth in a fixed rack, and a spring-lever fulcrumed on the hand-lever and coupled to the sliding bolt, substantially as set forth.

4. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a rotating distribution-valve governing the supply and exhaust of steam to and from said cylinders, and a driving-spindle coupled at one end to said valve and at the other to a bevel-gear engaging a similar gear fixed upon the crank-shaft, substantially as set forth.

5. The combination of two or more single-acting cylinders located side and side above a closed crank case or chamber at right angles to a common crank-shaft therein, pistons fitting said cylinders and coupled to crank-pins on said shaft, a main or distribution valve governing the supply and exhaust of steam to and from said cylinders and connected to a spindle which is rotated by gearing from the crank-shaft, and an exhaust-steam passage leading through said spindle and establishing communication between the valve and the crank-case, substantially as set forth.

6. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a rotating main or distribution valve coupled to a driving-spindle and governing the supply and exhaust of steam to and from said cylinders, and a bevel-gear fitted with the capacity of limited circumferential movement on the driving-spindle and engaging a similar gear fixed upon the crank-shaft, substantially as set forth.

7. The combination of two or more single-acting cylinders located side and side at right angles to a common crank-shaft, pistons fitting said cylinders and coupled to crank-pins on said shaft, a rotating main or distribution valve coupled to a driving-spindle and governing the supply and exhaust of steam to and from said cylinders, a bevel-gear fitted with the capacity of limited circumferential movement on the driving-spindle and engaging a similar gear fixed upon the crank-shaft, a bevel-gear fixed upon the driving-spindle, and a hand-operated bevel-gear adapted to be rotated in a fixed bearing and to engage the bevel-gear which is fixed to the driving-spindle, substantially as set forth.

8. The combination, in a single-acting cylinder, of a higher-temperature or steam-end section, a lower-temperature section, and heat-intercepting packing interposed between

flanges through which the sections are connected, substantially as set forth.

9. The combination of two or more single-acting cylinders, pistons fitting therein and coupled to crank-pins on a common crank-shaft, a distribution-valve governing the supply and exhaust of steam to and from said cylinders and rotated by a driving-spindle having an internal exhaust-passage, and heat-intercepting packing inclosing said spindle and separating the same from the shells of the cylinders, substantially as set forth.

10. The combination of two or more single-acting cylinders, pistons fitting therein and coupled to crank-pins on a common crank-shaft, a main or distribution valve located above the heads of the cylinders and governing the supply and exhaust of steam to and from said cylinders, and a steam-jacket covering the heads of the steam ends of the cylinders and forming part of the passage for steam from the boiler to the distribution-valve, substantially as set forth.

11. The combination of two or more single-acting cylinders having their pistons coupled to crank-pins on a common crank-shaft, a steam-jacket covering the heads of the cylinders, and relief-valves closing openings leading from the steam ends of the cylinders into the steam-jacket, substantially as set forth.

In testimony whereof I have hereunto set my hand.

ROBERT CREUZBAUR.

Witnesses:
CHAS. S. PEASE,
W. L. MCCULLAGH.