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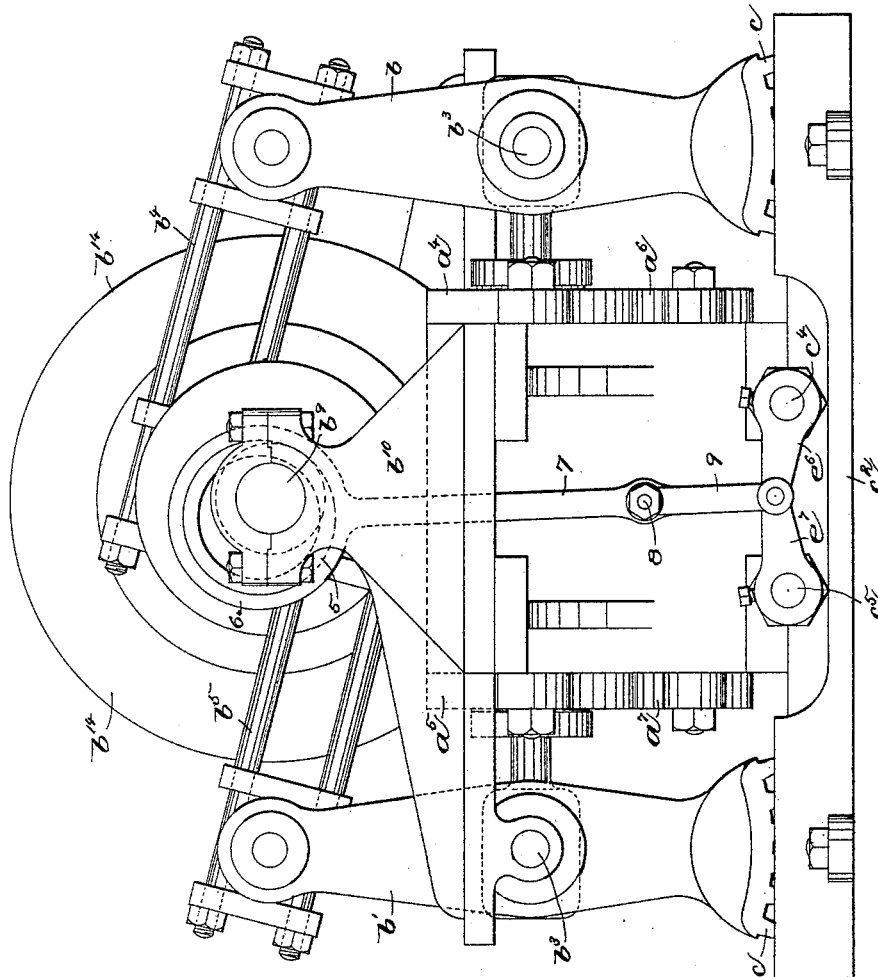
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J. A. LIDBACK.  
STEAM ENGINE.

No. 419,053.

Patented Jan. 7, 1890.

Fig. 1.



Witnesses.  
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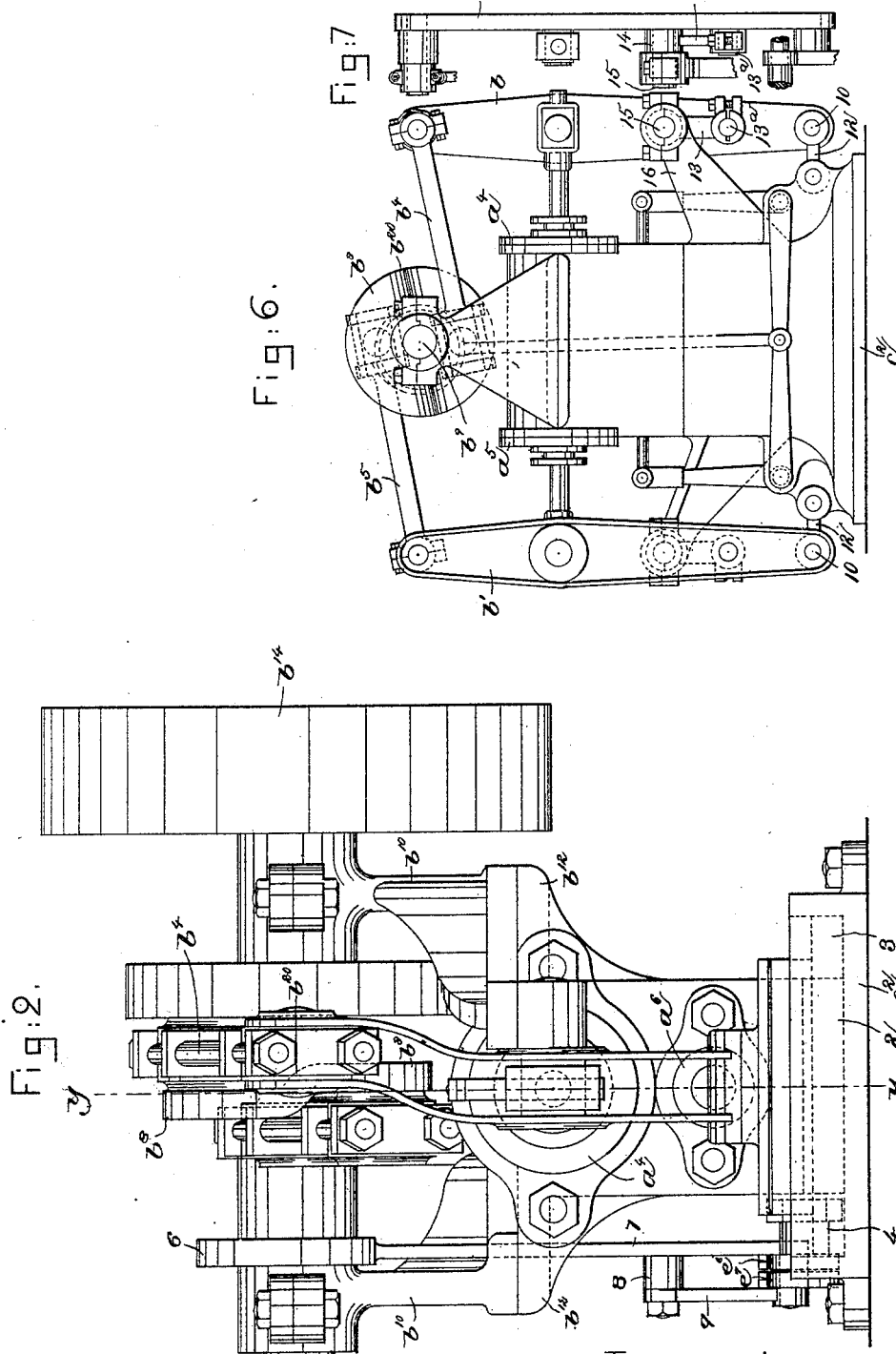
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Fig: 5.

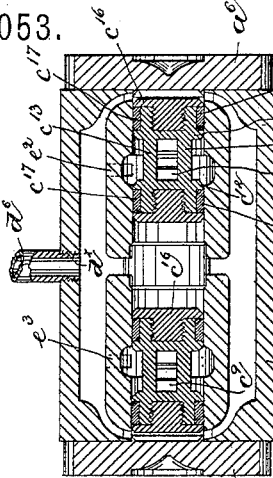


Fig: 4.

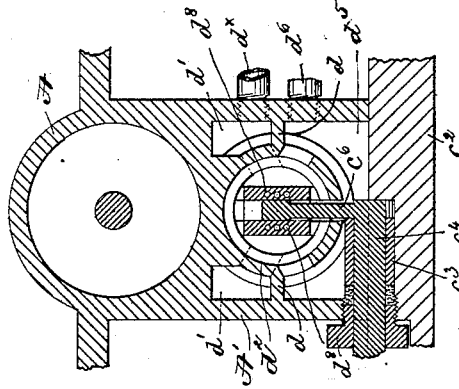
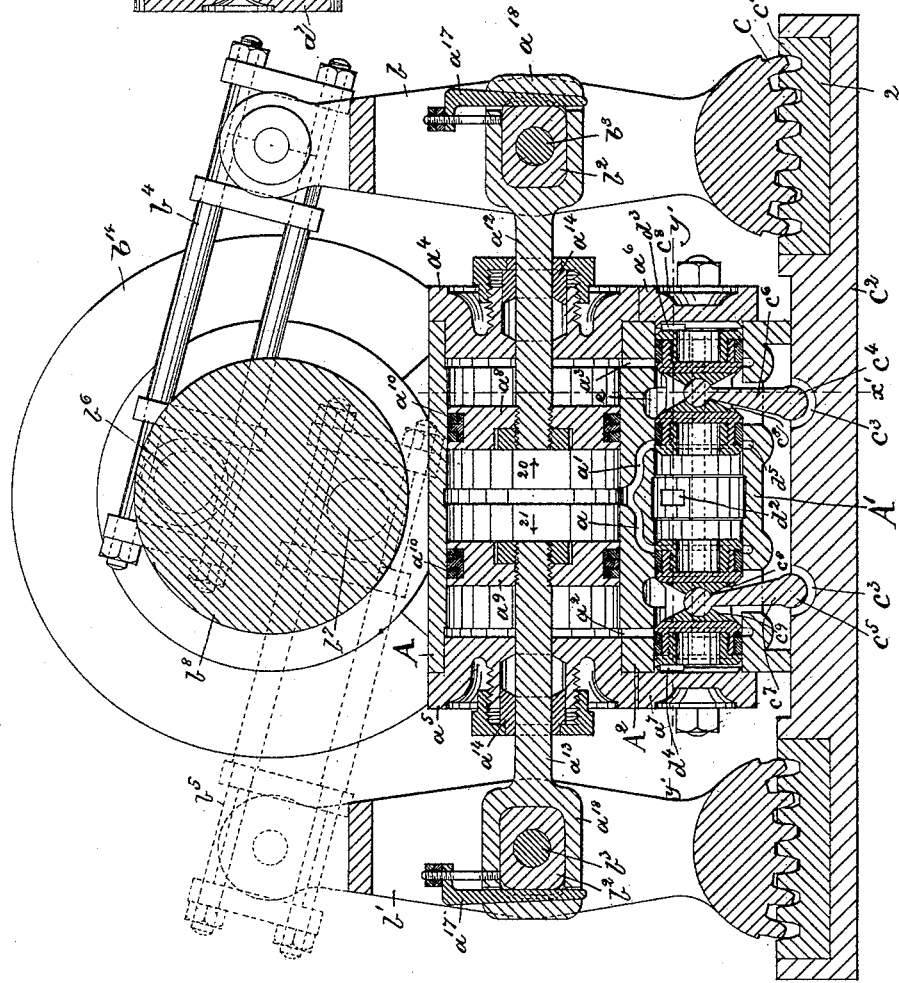


Fig: 3.



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# UNITED STATES PATENT OFFICE.

JOHN A. LIDBACK, OF PORTLAND, MAINE.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 419,053, dated January 7, 1890.

Application filed April 2, 1889. Serial No. 305,691. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN A. LIDBACK, of Portland, county of Cumberland, State of Maine, have invented an Improvement in Steam-Engines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to reciprocating engines of that class known as "high-speed" engines, and has for its object to construct a balanced engine, as will be described, whereby a small and compact balanced engine capable of running at a substantially high speed is obtained at a minimum cost.

In accordance with my invention the steam-cylinder and valve-chest are located below the main or crank shaft, which is supported in suitable bearings by the steam-cylinder, thereby economizing in space and especially adapting my improved engine for marine purposes. The steam-cylinder is provided, as herein shown, with two pistons having their piston-rods extended through the opposite ends or heads of the steam-cylinder and directly connected to rockers operatively connected at one end to the main shaft and constructed at their lower ends, as will be described, whereby the pistons and their piston-rods will move in a straight line in opposite directions. The valves—preferably piston-valves—are connected to an eccentric on the main shaft, as will be described, so as to reciprocate in opposite directions, the said piston-valves being provided with steam-circulating ports, so that the steam in the valve-chest may circulate freely through the valve to effect a perfect balance of the same.

My invention therefore consists, essentially, in the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the opposite ends or heads of the said cylinder, a main shaft located above the said steam-cylinder and having cranks and rockers connected to said piston-rods and to the said cranks to produce opposite reciprocations of the said pistons, and oppositely-reciprocating piston-valves to

actuate said pistons, substantially as will be described.

Other features of my invention will be pointed out in the claims at the end of this specification.

Figure 1 is a side elevation of one form of steam-engine embodying my invention; Fig. 2, an end elevation of the engine shown in Fig. 1; Fig. 3, a longitudinal section of the engine on line *y y*, Fig. 2; Fig. 4, a transverse section of the engine on line *x x*, Fig. 3; Fig. 5, a longitudinal section through the valve-chest on line *y y*, Fig. 3; Fig. 6, a side elevation of the engine, showing a modified form of rocker; and Fig. 7, a detail in elevation of the rocker shown in Fig. 6.

The steam-cylinder A, preferably cast in one piece with the valve-chest A', is located above the said valve-chest and separated therefrom by a division-wall A<sup>2</sup>, provided, as herein shown, with passages *a a'*, *a<sup>2</sup> a<sup>3</sup>*, forming ports which connect the said valve and steam-chests, the ports *a a'*, located near the center of the said wall, having a common outlet into the steam-cylinder, and the ports *a<sup>2</sup> a<sup>3</sup>* communicating with the opposite ends of the said steam-cylinder.

The steam-cylinder A is provided at its ends with suitable heads *a<sup>4</sup> a<sup>5</sup>*, and the valve-chest with heads *a<sup>6</sup> a<sup>7</sup>*, secured thereto in any suitable manner.

The steam-cylinder A, as herein shown, contains within it two pistons *a<sup>8</sup> a<sup>9</sup>* of any usual construction and provided with suitable packing-rings *a<sup>10</sup>*, and the said pistons are provided with piston-rods *a<sup>12</sup> a<sup>13</sup>*, extended through the cylinder-heads *a<sup>4</sup> a<sup>5</sup>*, respectively, and, as herein shown, through suitable stuffing-boxes *a<sup>14</sup>*, secured to said cylinder-heads.

The piston-rods *a<sup>12</sup> a<sup>13</sup>* are respectively connected, as shown, to rockers *b b'*; as by keys *a<sup>17</sup>*, extended through yokes *a<sup>18</sup>* on the end of the said piston-rods, the said yokes, as herein shown, being fitted upon blocks *b<sup>2</sup>*, secured to or forming part of pins *b<sup>3</sup>* on the said rockers.

The rockers *b b'* are connected at their upper ends by suitable connecting-rods *b<sup>4</sup> b<sup>5</sup>* (see Fig. 3) to crank-pins *b<sup>6</sup> b<sup>7</sup>*, (see dotted lines,

Fig. 3,) herein shown on substantially diametrically opposite sides of a crank-disk  $b^8$ , mounted on a main shaft  $b^9$ , having bearings, as herein shown, in pillow-blocks  $b^{10}$ , (see Fig. 2,) supported by brackets  $b^{12}$ , secured to or forming part of the steam-cylinder, the said main shaft being provided with the usual driving-pulley  $b^{14}$ .

The rockers  $b$   $b'$  are provided at their lower ends, as shown in Fig. 3, with teeth  $c$ , which mesh with teeth of a rack-bar made, as herein shown, in three sections 2, 3, and 4, (see Fig. 2,) the sections 3 and 4 being located on opposite sides of the central section 2, and all the sections being supported by a bed-plate  $c^2$ , the central section 2 of the rack-bar being adjustable longitudinally to compensate for wearing away of the teeth, and thus prevent lost motion between the teeth of the rocker and the said rack-bar.

The bed-plate  $c^2$  has secured to or forming part of it sleeves  $c^3$ , (see Figs. 3 and 4,) forming bearings for rock-shafts  $c^4$   $c^5$ , provided at their inner ends with rocker-arms  $c^6$   $c^7$ , the said arms, as herein shown, being rounded or made ball-shaped at their upper ends (see Fig. 3) to engage cup-shaped sockets in sliding blocks  $c^8$   $c^9$ , forming part of piston-valves within the valve-chest.

Each piston-valve is preferably composed of two disks  $c^{10}$   $c^{12}$ , united by webs  $c^{13}$ , (see Fig. 5,) which form a guideway, into which the blocks  $c^8$   $c^9$  are inserted, and in which the said blocks reciprocate in a vertical direction, as herein shown, to produce reciprocation of the valve in a horizontal direction.

The disks  $c^{10}$   $c^{12}$  are provided on their outer faces, as herein shown, with a threaded collar or flange  $c^{14}$ , to be engaged by a threaded nipple on disks  $c^{16}$ , between which disk and the disks  $c^{10}$   $c^{12}$  are placed the usual packing-rings  $c^{17}$ .

The piston-valves are reciprocated toward and from each other by means of an eccentric 5 on the main shaft  $b^9$ , the said eccentric being connected by the usual strap 6 and eccentric-rod 7 to an arm  $e^6$  on the rock-shaft  $c^4$ , and the said eccentric, as herein shown, is provided with a stud 8, to which is connected one end of a link 9, having its other end connected to the arm  $e^7$  on the rock-shaft  $c^5$ .

The upper part of the valve-chest  $A'$  forms with side walls of the outer shell or casting and with horizontal division-walls  $d$  (see Fig. 4) chambers  $d'$ , which extend longitudinally the length of the said valve-chest on both sides, and communicate on both sides with the interior of the said chest by means of central ports  $d^2$  and end ports  $d^3$   $d^4$ , one of the said chambers having connected to it a steam-inlet pipe  $d^x$ . The lower portion of the valve-chest forms, with the side walls of the casing and the bed-plate  $c^2$ , an exhaust chamber or space  $d^5$ , provided with an outlet-pipe  $d^6$ .

The webs  $c^{13}$  of the valve and the collar  $c^{14}$  and disks  $c^{16}$ , substantially in line with the

said webs, are provided with openings or holes  $d^8$ , (see Fig. 4,) through which steam may circulate from one to the other side of the valve.

The operation of the engine as thus far described is as follows: Steam is admitted through the inlet-pipe  $d^x$  into the chamber  $d'$  communicating therewith, and passes through the ports  $d^2$   $d^3$   $d^4$  into the chamber  $d'$  on the opposite side of the valve, so that practically both chambers  $d'$  are filled with steam. As shown in Fig. 1, the pistons  $a^8$   $a^9$  are moving in opposite directions, as indicated by arrows 20 and 21, the piston-valves being at such time near the end of their strokes in the direction indicated by said arrows, the ports  $a$   $a'$  being about to be opened for the admission of live steam into the steam-cylinder, and the ports  $a^3$   $a^3$  about to be opened to the exhaust-ports  $e$   $e'$  in the wall  $A'$ , the said exhaust-ports communicating with the exhaust-chamber  $d^5$  through the ports  $e^2$   $e^3$ . (See dotted lines, Fig. 5.) As the pistons  $a^8$   $a^9$  are moved toward the end of their cylinder in opposite directions, the main shaft is rotated through the rockers  $b$   $b'$  and connecting-rods  $b^4$   $b^5$ , and by means of the rack-bar  $c'$  and teeth  $c$  on the said rocker-bars the points of connection between the piston-rods  $a^{12}$   $a^{13}$  and the said rocker-bars, which points of connection may be regarded as the pins  $b^3$ , move in the same straight line, and thus insure a true running of the piston. When the pistons  $a^8$   $a^9$  have reached the end of their strokes in the directions indicated by arrows 20 and 21, the valves through the eccentric 5 and rock-shafts  $c^4$   $c^5$  are moved toward each other to connect the ports  $d^3$   $d^4$  with the ports  $a^3$   $a^2$  and the ports  $a'$   $a$  with the exhaust-ports  $e'$   $e$ , the steam passing through the ports  $d^3$   $d^4$  into the steam-cylinder behind the pistons  $a^8$   $a^9$  through the ports  $a^3$   $a^2$ . As the valves are moved toward each other, the live steam in the valve-chest between the said pistons is permitted to pass or circulate from one side of the piston to the opposite side thereof through the holes  $d^8$ , and thus relieve the said piston-valves from undue pressure on one side thereof and effect a perfect balance and an easy running of the valves.

I do not desire to limit myself to the particular form of rocker herein shown, by which a true running of the pistons is obtained, as other forms by which the same results may be accomplished may be used—as, for instance, such as shown in Figs. 6 and 7, wherein each rocker is connected at its upper end to the connecting-rods, and is pivoted at its lower end, as at 10, to a link 12, pivotally connected to a solid support as a part of the casting or base of the engine. The rocker is also pivotally connected, as at 13, to a link or arm 13, forming part of a hub 14 on a pin 15, supported by the casting or bracket 16.

The speed of the engine may be regulated by any usual or well-known form of governor.

A crank-disk  $b^8$  is bent or offset substantially at its center, as at  $b^{20}$ , so that the crank-shaft boxes secured on opposite sides of the said disk come substantially in line with the offset portions or halves of the crank-disk, whereby a more compact engine is obtained.

As shown in the drawings, the piston-valves are made of such size as not to completely uncover the ports  $a^2$   $a^3$  when the said valves are moved to their extreme outward position; but in practice they will be made so as to uncover the whole of the ports.

I claim—

1. In a steam-engine, the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the opposite ends or heads of the said cylinder, a main shaft located above the said steam-cylinder and having cranks and rockers connected to said piston-rods and to the said cranks to produce opposite reciprocations of the said pistons, and oppositely-reciprocating piston-valves to actuate said pistons, substantially as described.

2. In a steam-engine, the combination, with a steam-cylinder and a valve-chest located below and communicating therewith, of pistons located in said cylinder and having piston-rods extending through the opposite ends or heads of the said cylinder, a main shaft located above the said steam-cylinder and having cranks set substantially opposite, rockers connected to said cranks and to the piston-rods, piston-valves located in said valve-chest, and an eccentric on the main shaft operatively connected to said valves, substantially as described.

3. In a steam-engine, the combination, with a steam-cylinder provided with a piston, a valve-chest located below and communicating with said steam-cylinder, and a valve in said chest, of a main or crank shaft supported above the said steam-cylinder and valve-chest, whereby economy in space is effected, substantially as described.

4. In a steam-engine, the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the ends or heads of the said cylinder, a main shaft having cranks operatively connected to said piston-rods to produce opposite reciprocations of the said pistons, piston-valves in said valve-chest provided with

circulating openings for the passage of the steam from one to the other side of the piston-valve, and means, substantially as described, to produce opposite reciprocations of the said valves, substantially as described.

5. In a steam-engine, the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the ends or heads of the said cylinder, a main shaft having cranks set substantially opposite, rockers connected to said cranks and to the said piston-rods, piston-valves in said valve-chest provided with circulating openings for the passage of steam from one to the other side of the piston-valve, and means, substantially as described, to produce opposite reciprocations of the said valves, substantially as described.

6. In a steam-engine, the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the ends or heads of the said cylinder, a main shaft having cranks set substantially opposite, rockers connected to said cranks and to the said piston-rods, valves in said valve-chest, rock-shafts connected to said valves, and an eccentric on the main shaft connected to said rock-shafts to produce opposite reciprocations of the said valves, substantially as described.

7. In a steam-engine, the combination, with a steam-cylinder and a valve-chest communicating therewith, of pistons located in said cylinder and having piston-rods extended through the ends or heads of the said cylinder, a main shaft having cranks set substantially opposite, rockers connected to said cranks and to the said piston-rods, piston-valves in said valve-chest provided with circulating openings for the passage of steam from one to the other side of the piston-valve, rock-shafts connected to said piston-valves and provided with arms  $e^b$   $e^c$ , and an eccentric on the main shaft connected to said arms, as and for the purpose specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN A. LIDBACK.

Witnesses:

ELMER G. GERRISH,  
GEO. L. GERRISH.