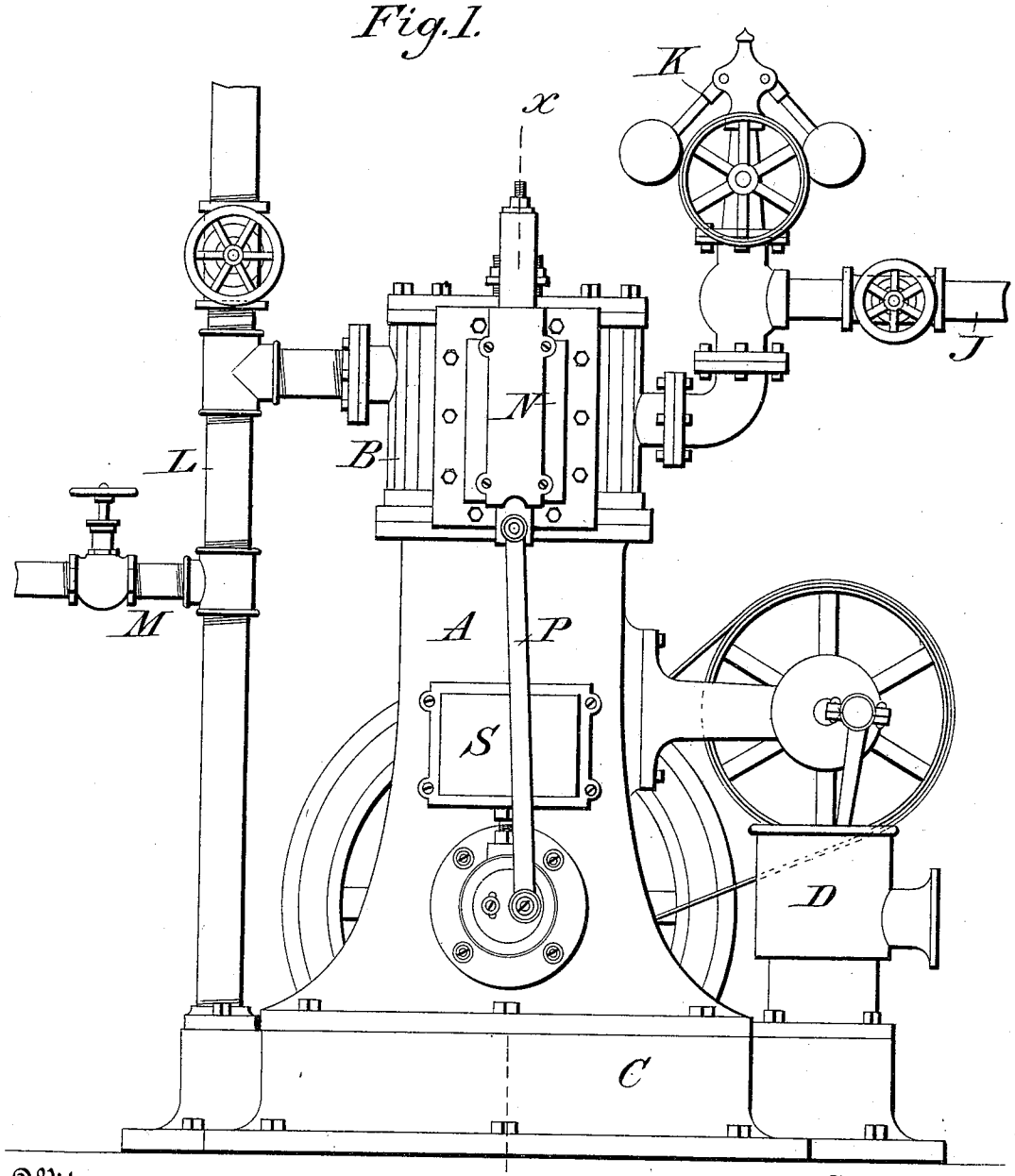
(No Model.) 3 Sheets—Sheet 1.

J. RICHARDS.

COMPOUND STEAM ENGINE.

No. 350,446. Patented Oct. 5, 1886.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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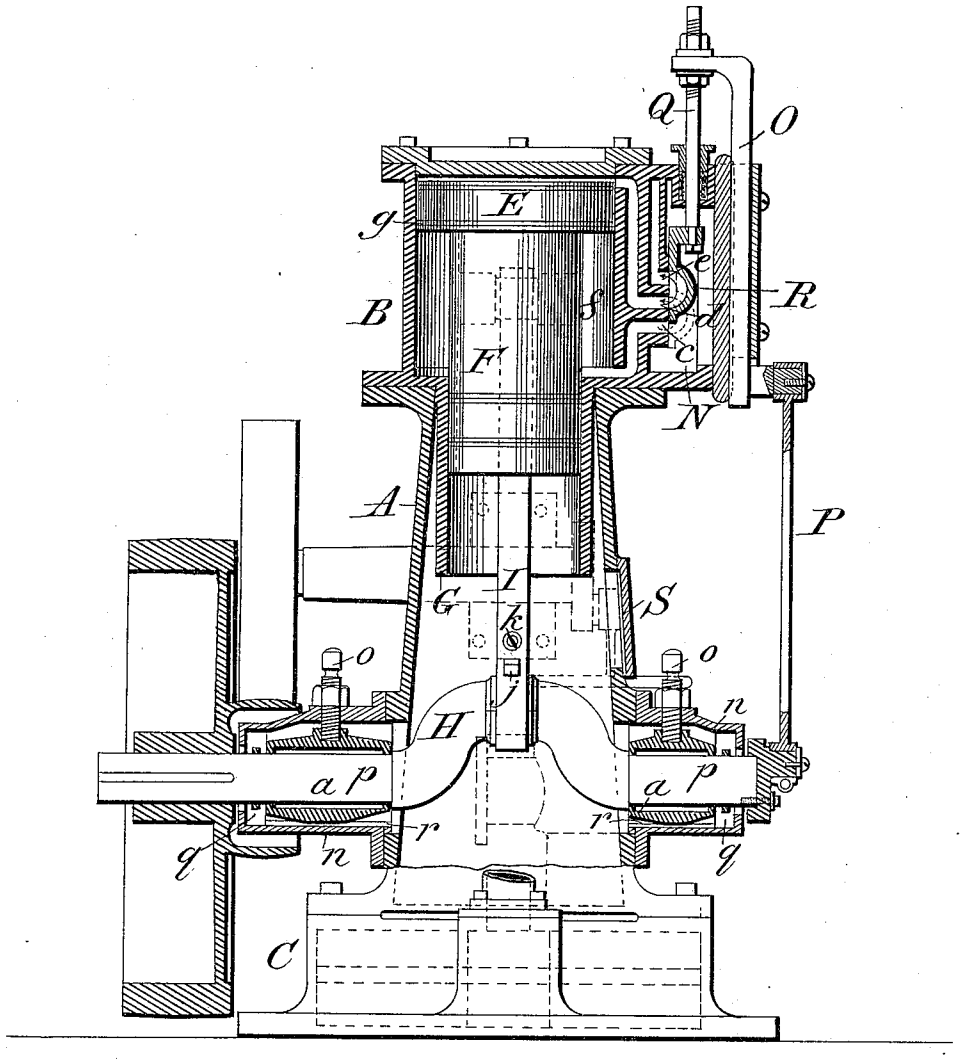
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 4.

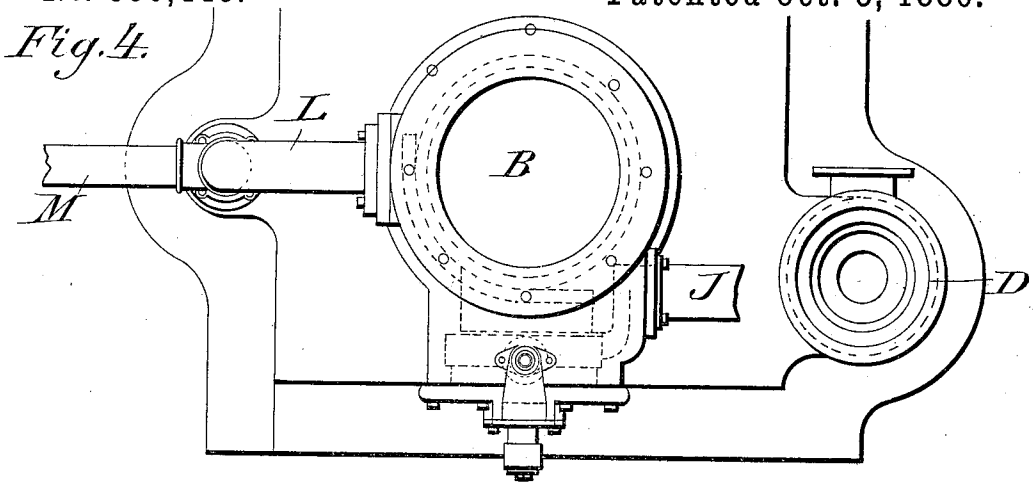
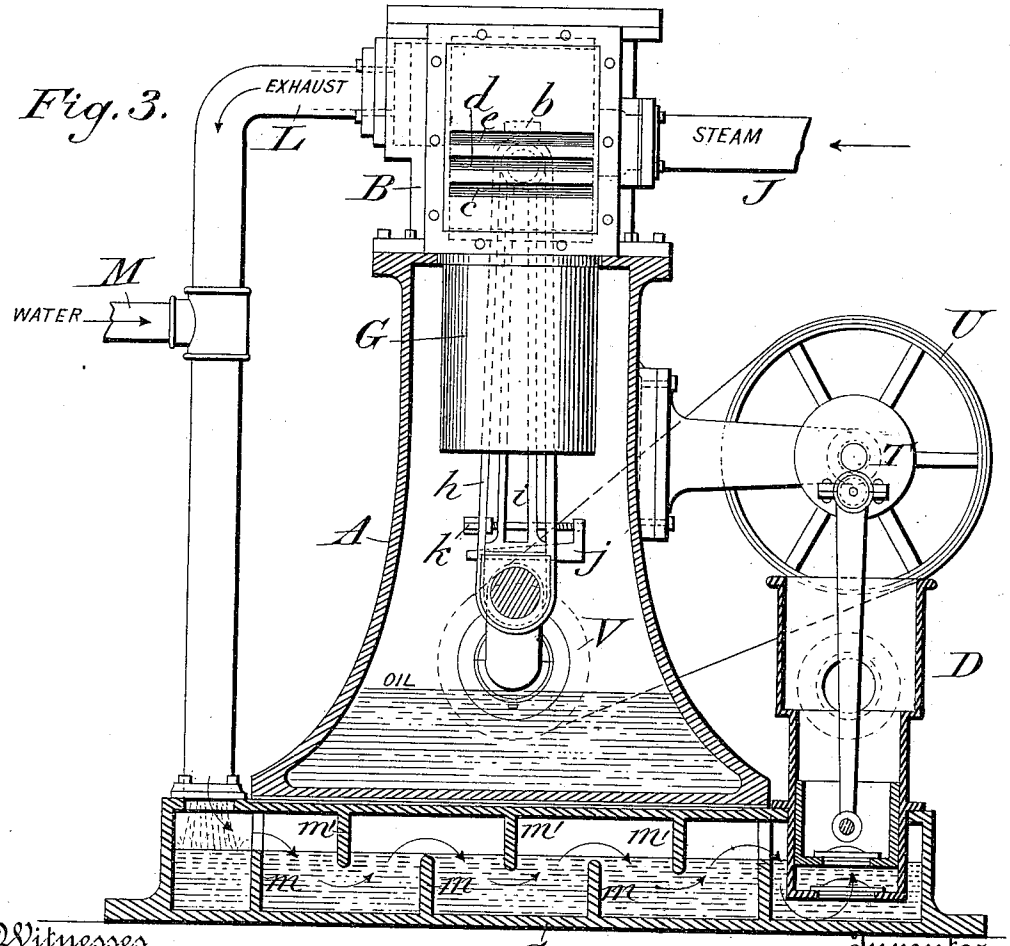


Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN RICHARDS, OF SAN FRANCISCO, CALIFORNIA.

COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 350,446, dated October 5, 1886.

Application filed May 13, 1886. Serial No. 202,042. (No model.)

To all whom it may concern:

Be it known that I, JOHN RICHARDS, a citizen of the United States, residing at San Francisco, in the county of San Francisco and State of California, have invented certain new and useful Improvements in Compound Steam-Engines; and I do 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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to the class of compound condensing steam-engines; and it consists of such an engine having a single steam-cylinder inclosing a steam-piston upon whose opposite sides or ends the steam acts successively, the area of the initial end of said piston being reduced by means of a trunk with which it is provided.

The invention further embraces a hollow supporting-column, which incloses the principal shaft-bearings of the engine in such a manner that a lubricating liquid placed within the column may be dashed into the bearings and thence drained back by suitable conduits to the oil-reservoir in like manner with similar methods now in use in single-acting engines having open-ended cylinders.

It consists also in constructing the base of the frame to serve as a condenser, by making said base hollow, and providing it with a series of vertical partitions or diaphragms, which are alternately secured to the top and bottom of the casing so that the exhaust-steam may be obliged to pass several times beneath the surface of the water in the condenser and thus become completely liquefied before it reaches the air-pump; and the invention also comprises certain peculiarities in the construction, arrangement, and combination of the various mechanical details, as will be hereinafter fully described.

In the annexed drawings illustrating my invention, Figure 1 is an elevational view of my improved steam-engine, showing the various parts in their relative position. Fig. 2 is a vertical section of the same on the line *x x* of Fig. 1, and parallel to the axis of the crank-shaft. Fig. 3 is a partial vertical section at right angles to the sections of Fig. 2, and transverse to the axial line of the shaft, and Fig. 4 is a partial top plan view.

Like letters of reference designate like parts throughout the several views.

A represents the main frame or hollow column, which supports thereon the cylinder B, and which is itself supported upon the base C, said base serving also as a condenser, as will be hereinafter explained.

D represents the casing of the air-pump, which is located to one side of the main frame.

The steam-cylinder B contains a steam-piston, E, which is formed with an extension, F, that fits closely within a downwardly-extending sleeve, G, secured to and preferably formed integral with the cylinder. A horizontal crank-shaft, H, is journaled at either end in bearings *a a*, and connects with the piston by means of a rod, I, properly secured to the piston and the shaft so that the reciprocation of the former may rotate the latter.

Steam is introduced to the cylinder by means of a steam-supply pipe, J, in connection with which is provided a governor, K, to regulate the motion and govern the supply of the inflowing steam. The exhaust-steam passes out through the pipe L into the condenser C, the water for the condensation being furnished by a water-supply pipe, M, which enters the pipe L. A valve for the exhaust-steam is also provided at the point *b*, Fig. 3, in order to allow the steam to pass out into the atmosphere when it is desired to operate the engine as a non-condenser.

N designates a valve chest or box containing a slide-valve, R, which is operated by the following connections with the crank-shaft H: A valve-crank, P, is secured eccentrically at its lower end to the outermost extremity of the shaft H, while the upper end of the crank is pivotally connected with a slide-bar, O, to which it imparts a reciprocating motion, and by this means operates a valve-rod, Q, and the slide-valve R, and thus opens and closes the ports *c d e* for admitting steam to the piston.

In considering the operation of the engine, suppose, first, that the valve R is in the position shown in full lines in Fig. 2, with the port *c* open. Steam will then pass from the box N through the port *c* and fill the space *f* beneath the piston E, which will be driven to the up-

per limit of its stroke, as shown. At the same time the exhaust-steam from the upper end of the cylinder will escape through the port *d* into the exhaust-port *e*, and thence to the pipe L. When the piston has thus completed its upward stroke the valve will be moved to the position shown in dotted lines in the same figure. The steam will then pass from beneath the piston through the port *c* into port *d*, and thence to the top of the piston E, forcing the same downward with a power equal to the difference between the area of the piston E and the trunk F, by virtue of the tension of the steam in its then expanded condition. In this way it will be seen how the same steam can be employed on both the bottom and top of the piston, and how it can be expanded to several times the initial volume by means of a single cylinder and a simple slide-valve. The trunk or piston extension F corresponds to the piston-rod and guide-bars of a common double-acting engine, and closes the bottom end of the main cylinder B in the same manner as a packing-gland. Both the piston (see Fig. 2) and the extension (see Fig. 3) are generally provided with packing-rings *g* to prevent the passage and escape of the steam; and the connecting-rod I is preferably made with an outer strap, *h*, and a strut, *i*, the latter acting on the top pin, so that the key *j* and screw *k* can operate to take up the wear at both ends. There being no packing-gland or cross-head slides, there is consequently no adjustment to be performed inside the main frame A, except that of the connecting-rod I. This construction permits, therefore, the inclosure of the parts for the purpose of lubrication, the same as in the case of single-acting engines. S represents a removable door in the main frame A, (see Figs. 1 and 2,) which permits of access to the key *j* or other mechanism for adjusting the bearings of the connecting-rod I. The exhaust-steam passes off but once at each whole revolution of the engine, its course being to enter the pipe L, proceed therein until it meets the water coming through the injector M, after which the commingled water and steam pass downward into the condenser C. This condenser C consists of a hollow box provided with a series of partitions or diaphragms, *m* and *m'*, the former of which, as *m*, are secured to the bottom of the casing, while the latter, as *m'*, are secured to the top. These partitions it will be noted extend but a portion of the distance between the top and bottom, and they preferably overlap each other, as shown, so that when the reservoir is partially filled with water, the several chambers thereof may be non-communicating, except by passage through the water. It will thus be seen that any steam not previously condensed by the water will, in its passage through the condenser to the pump, be obliged to pass several times beneath the surface of the water, as shown by the arrows in Fig. 3, and thus become completely liquefied. The water of injection and condensation is drawn off by means of the pump D, which is driven by the crank-wheel T and the pulleys U and V and their connections.

The bearings *a a*, above referred to, of the main shaft H are inclosed within flanged shells or housings *n n*, which are bolted or otherwise firmly secured to the main frame A, and are provided with screws *o o* to keep the main bearings *p p* in proper adjustment. The engine being double-acting, these bearings are subject to strain in two directions. The screws *o o* being placed outside, the adjustment is made without opening the door S. The lower portion of the main frame A serves as an oil-receptacle, and as the shaft H revolves the oil or other lubricating liquid contained within the receptacle will be splashed into the bearings. Passing through the bearings this oil will be arrested in the chambers *q*, whence it will be drained back into the main receptacle by means of channels *r*.

As shown in Fig. 3, the main frame is partially filled with oil and the crank on its lower stroke enters the oil and dashes it upward.

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

1. In a steam-engine, the hollow sole-plate or condensing-chamber provided with a series of diaphragms secured alternately to the top and bottom walls, substantially as and for the purposes described.

2. In a double-acting steam-engine, the combination of the exhaust-pipe, the water-supply, the hollow sole-plate or condensing-chamber provided with a series of diaphragms secured alternately to the top and bottom walls, and the pump for removing the water, substantially as shown and described.

3. In a double-acting steam-engine, the combination of the main frame, the differential cylinder mounted thereon, the trunk-piston, the slide valve and ports, the exhaust-pipe, the water-supply, and the hollow sole-plate or condensing-chamber provided with a series of diaphragms secured alternately to the top and bottom walls, substantially as described.

4. In a steam-engine, the combination of the main inclosing-frame A, the cylinder B, having a downwardly-extending sleeve, G, the piston E, working in the cylinder and having a trunk, F, working in the sleeve, the crank-shaft H, connecting-rod I properly secured to the piston and the shaft, together with suitable adjusting mechanism for the rod, all arranged as described.

5. In a steam-engine, the main inclosing-case A, provided with shaft-bearings *a a*, inclosed within flanged shells *n n*, having screws *o o* adjustable from outside the casing and having also oil-channels *q* and *r*, substantially as described.

6. In a double-acting steam-engine, the main inclosing-casing A, having a removable door, S, and containing the shaft H, journaled in

bearings *a a*, inclosed by shells *n n* and held in place by externally-adjustable screws *o o*, said casing A being located directly over the sole-plate C, and in combination with a differential cylinder mounted on the casing, substantially as shown and described.

7. In a steam-engine, the combination, with the main frame, the cylinder, the piston, crank-shaft, and connections, of the exhaust-pipe for the steam, the water-supply, the chambered condenser forming the base of the engine provided with a series of diaphragms secured alternately to the top and bottom walls, and the outflow-pump for the water, substantially as described.

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

JOHN RICHARDS.

Witnesses:
W. C. ERSKINE,
ALEXR. ERSKINE.