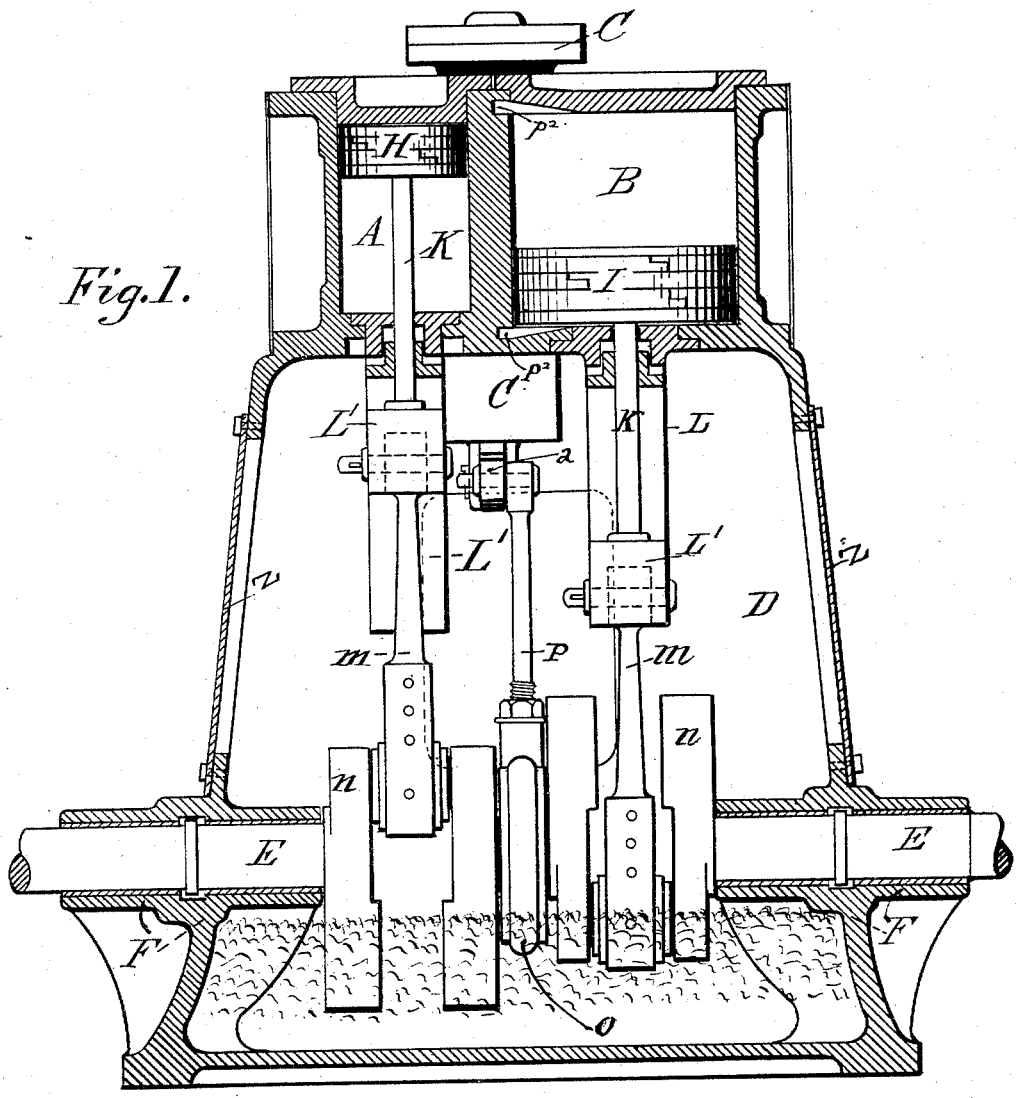
(No Model.) 3 Sheets—Sheet 1.

J. H. EICKERSHOFF.

STEAM ENGINE.

No. 456,694. Patented July 28, 1891.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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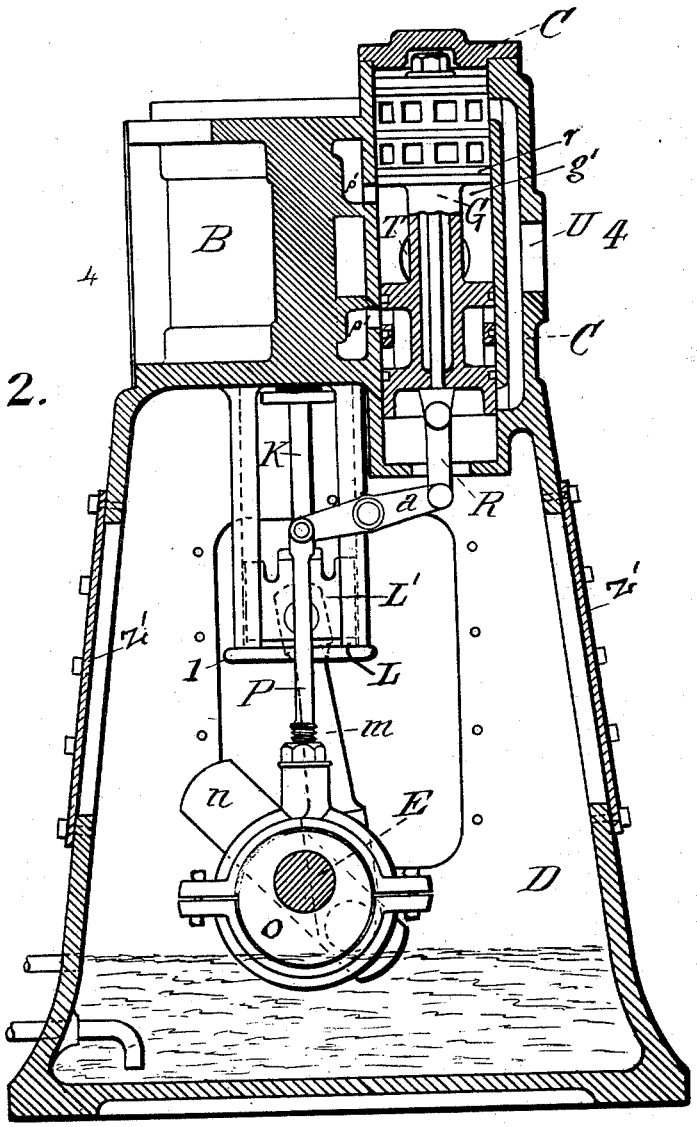
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

J. H. EICKERSHOFF.

STEAM ENGINE.

No. 456,694. Patented July 28, 1891.

Fig. 3.

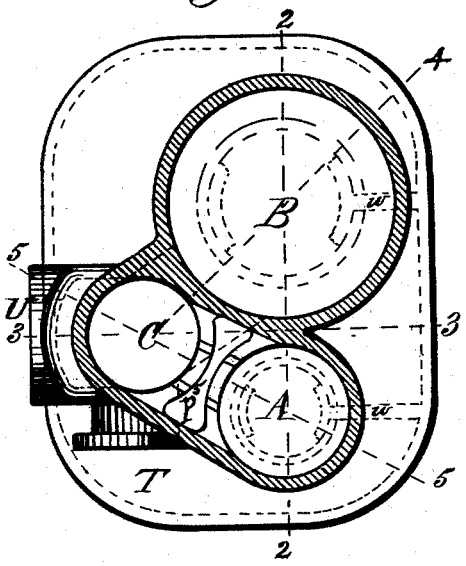


Fig. 5.

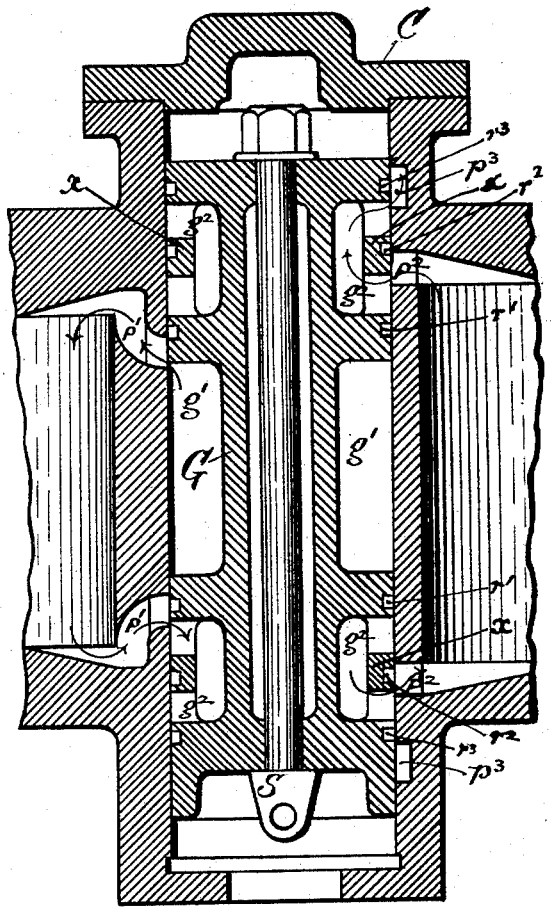
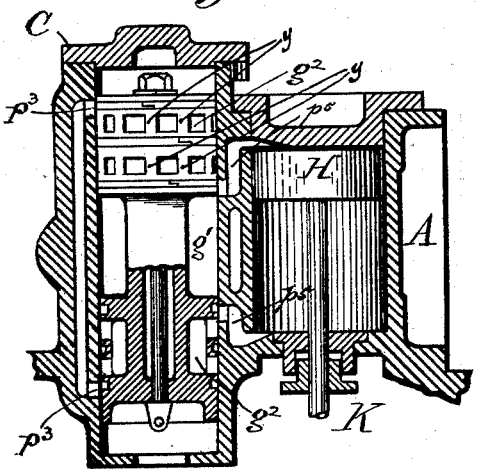


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO, ASSIGNOR TO LEOPOLD FEIST, OF SAME PLACE.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 456,694, dated July 28, 1891.

Application filed February 14, 1891. Serial No. 381,454. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. EICKERSHOFF, a citizen of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Steam-Engines, of which the following is a specification.

My invention relates to compound steam-engines, its object being to produce a compact engine embodying simplicity, durability, and economy of construction upon familiar type lines, high efficiency and economy in the utilization of steam and development of power, facility of handling, maintenance, and repair, and, in brief, to combine these and other advantages in a form adapting the engine to the widest range of usefulness as a driving-motor for general purposes in the hands of ordinary workmen without requiring the special skill demanded by the more complicated modern structures of this class.

To this end my invention consists in an upright double-acting engine of two cylinders—viz., a high and low pressure or "expansion" cylinder—having piston connections with oppositely-set cranks upon the same shaft, and in which the admission, expansion-over, and final exhaust of steam in relation to both cylinders are controlled by a single balanced valve operated by the main shaft.

Mechanism embodying my invention is illustrated in the accompanying drawings, in which—

Figure 1 is a vertical elevation of the engine complete in the common axial plane of the driving-cylinders, the cylinders and crank-cases being sectioned to show construction; Fig. 2, an end elevation of the engine with the crank-case and valve-chest sectioned upon the dotted line 3 of Fig. 3 to show construction; Fig. 3, a top view of the engine cross-sectioned horizontally through the driving and valve cylinders, showing their relative positions; Fig. 4, a vertical axial section upon dotted line 5 of Fig. 3 through the common axial plane of the valve-chest and high-pressure cylinder, showing the relation of the valve and its ports to the distribution-ports of the high-pressure cylinder; Fig. 5, a vertical axial section taken upon the two planes indicated by dotted lines 4 and 5 of Fig. 3, showing isometrically the relations of the valve to the distribution-ports of both cylinders and the exhaust-ports of the low-pressure cylinder.

Referring now to the drawings, A designates the high-pressure cylinder; B, the low-pressure or expansion cylinder; C, the valve cylinder or chest; D, the supporting-frame or crank-case, and E the main shaft, journaled in bearings F in opposite end walls of the crank-case.

When constructed in preferred form with a view to economy of production, the high and low pressure cylinders, valve-cylinder, crank-case, and shaft-bearings, together with the cross-head slides L, (as projections of the lower cylinder-heads,) are all cast together as one piece. The casting is then subjected to the action of a special boring and facing machine, by which the boring of the cylinders and cross-head guides, the facing of the rear ends of the cylinders and of the bottom of the bed plate or frame is performed, and an absolutely true alignment secured by the operation of parallel spindles operating together, thus effecting a considerable saving in cost and maintenance.

The construction and arrangement of the pistons H I, pitmen M, and cranks N are according to familiar practice and require no further description. The cross-head guides are longitudinal projections of diametrically-opposite arcs of a cylinder, secured at their outer ends by rings *l*, and each set backed at one side by a web *w*, extending to and connected with the adjacent wall of the crank-case for the more secure bracing of the parts. The arc-shaped guides are disposed in each case in the plane of crank motion and the continuous longitudinal spaces between afford easy access to the cross-heads and pitman connections to take up the lost motion of wear, &c., at any part of the stroke. The open construction of the guides also facilitates the lubrication by the splashing of the contained oil and water of the crank-case. The cross-heads are of the common type shown, adapted to the guides and provided with adjustable sliding surfaces.

To afford access to the guides and cross-heads, openings are provided at each end of the crank-case fitted with removable covers Z, which in place are fitted with tight joints.

The distribution-valve G is an elongated piston-valve having a central annular groove g', constituting with the end walls a port exclusively governing the distribution of live steam to the ports of the high-pressure cylinder, and two similar annular grooves g^2, one at each end, each governing alternately the expansive distribution of steam from the high-pressure to the low-pressure cylinder and the succeeding final exhaust of steam from the low-pressure cylinder. The valve-chest C is located in the angle of junction to and relatively between the high and low pressure cylinders A B, lying closely adjacent to the low-pressure cylinders, so that the shells merge in a common separating-partition, but offset from the high-pressure cylinder by a space p^5 near each end, constituting passages for the steam-delivery. Its ports p' p' for the transmission of live steam to the high-pressure cylinder (high-pressure ports) are brought relatively close together, so as to open alternately into the central live-steam groove g' of the valve, said ports being extended by the intervening passages referred to, as indicated in Fig. 4, outward to the ends of the high-pressure cylinder. Its ports p^2 p^2 (low-pressure ports) for the expansion of steam from the high-pressure over into the low-pressure cylinder and for the ultimate exhaust of steam from the latter open directly, as indicated in Fig. 5, into the low-pressure cylinder at the ends of the latter. Its final exhaust-ports p^3 p^3 are, by the vertical extension of the valve-chest beyond the working-cylinders, located at approximately the same relative distance outward beyond the horizontal plane of the low-pressure ports, as the high-pressure ports are located inward beyond the plane of said low-pressure ports. The intervening vertical distance between the high and low pressure ports of the working-cylinders is bridged at one extreme position of the valve by the end groove g^2 of the valve, whereby the spent steam is expanded over from the high into the low pressure cylinder through the valve-chest and ports p' p^2, and at the opposite extreme position of the valve the same end groove or port of the valve bridges and connects the end port p^2 of the low-pressure cylinder with the ultimate exhaust-port p^3 at that end of the valve-chest, the exhaust-ports p^3 connecting to a common discharge-pipe U.

The construction and arrangement of the valve G and its grooves or ports and the steam ports and passages of the cylinders and valve-chest retain a body of live steam centrally in the valve, exactly balancing pressures and conserving heat to the best advantage in the surrounding parts, and the relation and dimensions of ports, valve, and valve travel are so arranged that the compression in the expansion-cylinder and valve-ports approximately restores the heat lost in exhausting, so that no loss is suffered during expansion over through said ports and passages into the expansion-cylinder.

The central groove g' of the valve G is entirely open peripherally and its bounding walls (constituting, also, the bounding inner walls of the adjacent grooves g^2) are provided with peripheral packing-rings r'. Each groove g^2 has a central peripheral ring x, constituting part of the peripheral surface of the valve connected across by bridges y to the adjacent surface and provided with a packing-ring r^2. The outer or end walls of the grooves g^2 are also provided with packing-rings r^3. The valve is pivotally connected by a link R, lever a, and connecting-rod P to the eccentric O upon the main shaft, and, if desired, the eccentric may form part of a shaft-governor to regulate the movements of the engine in the usual manner of automatic cut-off constructions.

The form and construction of the crank-case, constituting the supporting-frame of the engine, are clearly indicated in the drawings. It is provided with side openings and removable covers Z' in addition to the openings and covers Z, by which convenient access is afforded to the working parts of the engine and constitutes a trough, in which is maintained a body of oil and water for lubrication in the usual manner.

The operation of the engine is as follows: Live steam, being admitted from the boiler to the valve-chest by the orifice T, (indicated by dotted lines, Fig. 2,) fills the central groove g' of the valve G, and is admitted alternately through the valve-chest ports p' and connecting-passages to opposite ends of the high-pressure cylinder A, performing the usual office of reciprocating the piston H. The valve G being moved to the opposite extremity of its reciprocation, the valve-groove g^2 then bridges and connects the high-pressure port p' with the end port p^2 of the low-pressure cylinder B, thereby enabling the steam to expand over into the low-pressure cylinder B from the high-pressure cylinder A upon the return-stroke of the piston H to compel the outstroke of the piston I. As the latter piston is concluding its outstroke, the valve is returned to its former position, and by its opposite groove g^2 bridges and connects the port p^2 with the adjacent exhaust-port p^3 and permits the spent steam to finally escape through exhaust-pipe U. The same description of movement applies to both ends of the cylinders and valve-chest, and as the motion of the shaft is continuous the proper reciprocation of the valve and the distribution of steam is duly effected. Suitable reversing-gear may also be provided to run the engine in either direction.

I claim as my invention and desire to secure by Letters Patent of the United States—

1. In a vertical duplex compound engine, a supporting crank-case having side and end openings, a high and low pressure working

cylinder mounted vertically thereon closely adjacent, an elongated valve-cylinder similarly mounted and joined to both working cylinders in the angle of their junction, and parallel longitudinal projections of opposite arcs depending from each working cylinder into the crank-case in pairs joined by a ring at the ends constituting independent cross-head guides for each working-cylinder, and shaft-bearings in opposite end walls of the crank-case in the common axial plane of the working cylinders, all cast together as an integral structure, substantially as set forth.

2. In a compound engine, the combination of parallel high and low pressure cylinders joined by a common separating-partition, a valve-cylinder in the angle of junction similarly joined to the low-pressure cylinder and joined to the high-pressure cylinder with a space toward each end between the shells, ports opening directly from the valve-cylinder into the ends of the low-pressure cylinder, and ports opening from the ends of the high-pressure cylinder into the spaces separating it from the valve-cylinder and thence from said spaces into the central portion of the valve-cylinder, substantially as set forth.

3. In a compound double-acting engine, the combination of a supporting crank-case having side and end openings, removable covers for said openings, a high and a low pressure working-cylinder mounted vertically closely adjacent thereon, independent opposite cross-head guides for each cylinder in the plane of crank motion, a crank-shaft with oppositely-set cranks with piston connections with said cylinders, a valve-cylinder arranged in the angle of the working cylinders closely adjacent to the low-pressure cylinder with ports opening directly thereto and set off from the high-pressure cylinder by the width of the steam-delivery passages from the central portion of the valve-cylinder to the ends of the high-pressure cylinder, a piston-valve effecting the entire steam-distribution of both cylinders, and connections thence to an eccentric upon the main shaft, substantially as set forth.

4. In a double-acting compound engine, the combination of a crank-case, a crank-shaft journaled therein having two oppositely-set cranks, a high and a low pressure cylinder mounted vertically upon the crank-case closely adjacent with a common separating-partition and in a common axial plane with the shaft, driving connections between the cylinders and cranks, a cylindrical valve-chest common to and parallel with the cylinders closely adjacent to both in the angle of their junction, a piston-valve reciprocating in said chest, an eccentric upon the shaft between the cranks, and a pivoted lever pivotally connected at one end with the valve and at the other with the eccentric, substantially as set forth.

5. In a double-acting compound engine, in combination with the high and low pressure cylinders and a cylindrical valve-chest common to both, a piston-valve having three elongated circumferential grooves or ports, peripheral packing-rings adjacent to both edges of each groove, and an annular dividing-surface provided with a packing-ring dividing each outer groove into two portions communicating below said dividing-surface, substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN H. EICKERSHOFF.

Witnesses:
L. M. HOSEA,
E. HOSEA.