

(No Model.)

J. H. EICKERSHOFF.
COMPOUND STEAM ENGINE.

No. 459,507.

Patented Sept. 15, 1891.

Fig. 1.

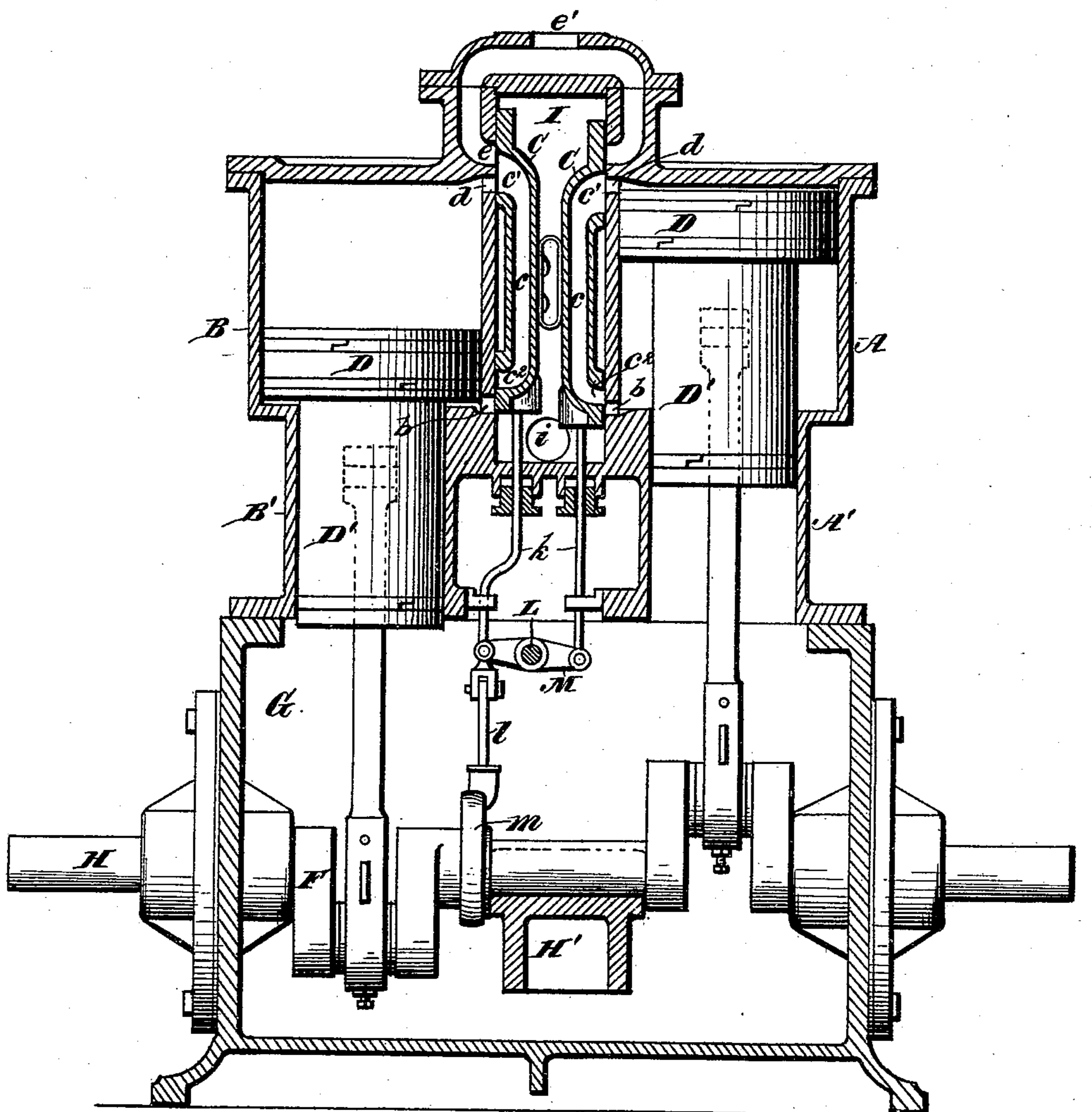
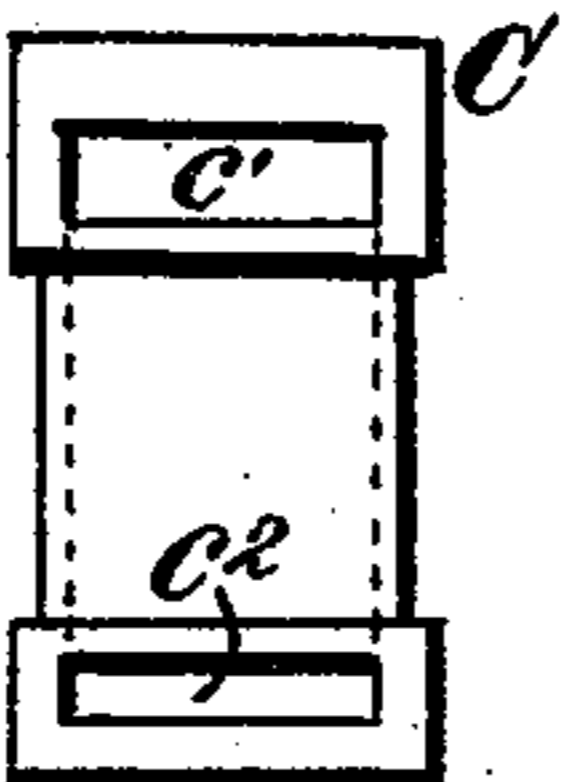
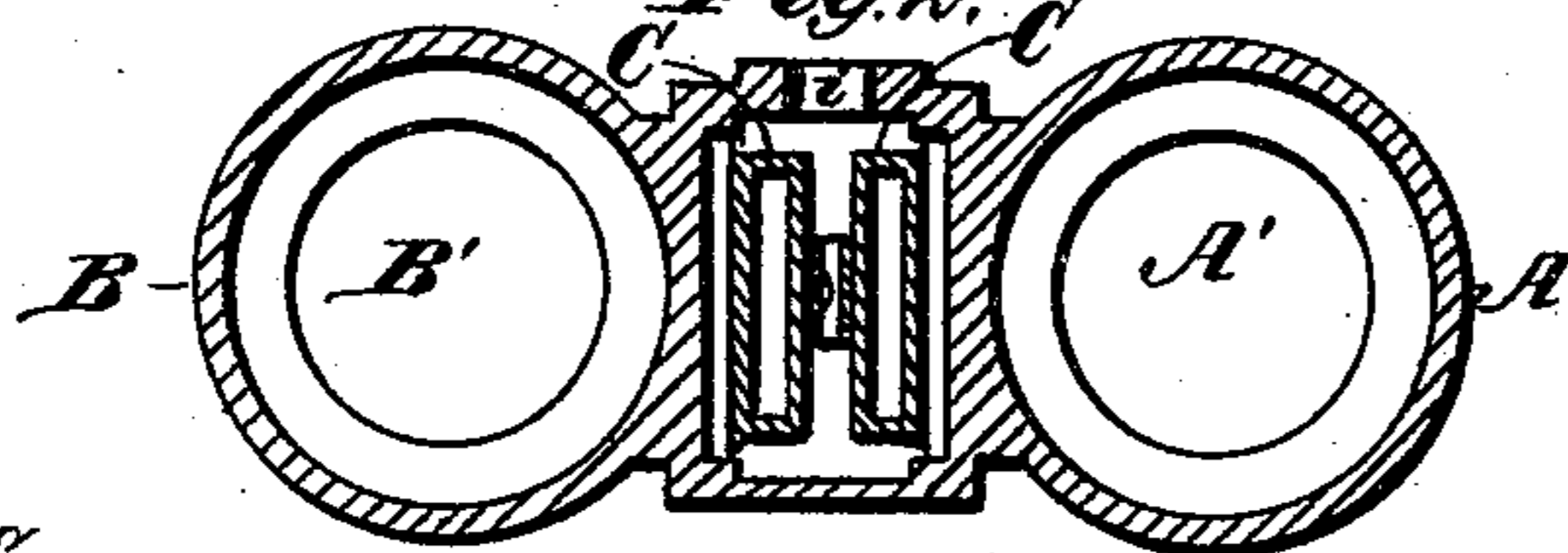


Fig. 2.



Witnesses.

Robert Emmett. *Fig. 3.*

Percy B. Hills.

Inventor.

John H. Eickershoff.

By *W. H. Fosua* *Atty.*

UNITED STATES PATENT OFFICE.

JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO, ASSIGNOR TO THE TRIUMPH
COMPOUND ENGINE COMPANY, OF SAME PLACE.

COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 459,507, dated September 15, 1891.

Application filed October 3, 1889. Serial No. 325,897. (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
5 Improvements in Compound Steam-Engines, of which the following is a specification.

My invention relates to compound steam-engines, its object being to produce, in economical and compact form, a compounding
10 engine in which the steam, after being utilized at boiler-pressure, is further expanded directly and without the intervention of a receiver against a piston of increased area.

To this end my invention consists in the
15 engine constructed and arranged as herein-after more fully set forth, embodying, as a leading constructive and operative principle, two steam-cylinders each of two diameters in successive axial portions, a corresponding
20 piston for each cylinder, consisting of a piston-head for the larger end of the cylinder extended at reduced diameter as an axial guide-plunger into the smaller end, a crank-shaft having driving-cranks set at opposite
25 radii and contained in a crank-case, pitman connections between the plunger-pistons and the cranks, respectively, and two independent distribution-valves moved by the shaft over suitable ports and having the triple function
30 of governing the induction, eduction, and transfer of steam in relation to the pistons.

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

35 Figure 1 is a vertical section of a preferred form of my invention through the common axial plane of the cylinders, passing centrally through the valve-chests and valves, showing the crank-shaft connections and valve-moving
40 mechanism in elevation; Fig. 2, a horizontal section through both cylinders and centrally through the valves on a reduced scale; Fig. 3, an under plan view of one of the duplicated valves on a reduced scale.

45 The general type of engines to which my invention is applied is that in which the cylinders are mounted (preferably) vertically above and open into a crank-case, through which the crank-shaft passes, having journal-
50 bearings in the end walls, and in which the cranks operate.

Constructive details are not material to my present invention, excepting as to those features specifically described.

The two cylinders A B, Fig. 1, are provided
55 with integral axial extensions A' B', of reduced diameter, projected forward toward the crank-shaft and opening into the crank-case G below, to which they are bolted. Each cylinder with its fittings is a duplicate of the
60 other and is closed above by a suitable head and provided with a piston D, extended by a close-fitting trunk or hollow plunger D' of properly-reduced diameter into the axial extension of the cylinder. The cylinders and
65 their axial extensions being truly bored from a common center alignment and the pistons and their extensions being truly turned in like manner, each piston with its extensions practically constitutes a cross-head of ex-
70 tended longitudinal bearing for the pitman, which is pivoted within the plunger-piston and coupled to the crank F in the crank-case G below.

I provide one or more packing-rings upon
75 each piston D, and also at the lower terminus of each extension, so that the pistons and their extensions may operate steam-tight in the cylinders and extensions, respectively. The crank-shaft H extends through the case
80 G in the common axial plane of the cylinders, having a bearing in the opposite end walls of the case, and is preferably provided with a bearing H' within the case centrally
85 between the cranks F.

Each steam-cylinder is provided with a valve-chest, a reciprocating slide-valve, and ports *b d*, opening through the shell of the cylinder to the interior thereof at or near the
90 respective ends and directly through the valve-seat. An exhaust-port *e* opens through the seat beyond the cylinder-head into a common exhaust-passage *e'*. The valve-chests communicate and may be considered as a single valve-chest I, common to both cylinders,
95 arranged between them, which brings the two valve-seats opposite and the slide-valves C C back to back. The valves are of the D variety, two-ported, having considerable lap, and a wide port *c'* at one end and a narrow
100 port *c''* at the other, the ports being connected by a hollow bridge or conduit *c*.

Steam enters the common valve-chest I at an aperture *i*, and surrounds the valve-conduit *c* and the valves, except their contact-faces, with the seats, so that the distribution of steam from the high-pressure to the low-pressure side of the pistons, which takes place through the valve-conduits *c*, occurs under most favorable conditions of temperature, and the valves are partially relieved of wearing-pressure upon seats. Each valve is provided with a reciprocating rod *k*, passing through a stuffing-box in the chest in the usual manner, and the valve-rods are preferably connected to opposite ends of an oscillating rocker-arm M, centrally pivoted at L and driven by a connecting-rod *l*, engaging an eccentric *m* upon the shaft, by which arrangement of parts the valves are driven simultaneously in opposite directions with the proper alternating motion by a single eccentric. I may also place on the back of one of the valves a spring-cushion *n*, bearing against the parallel face at the back of the opposite valve to hold them properly to seats when steam is shut off, yet admit of yielding under excess of back-pressure.

The general operation is as follows: Steam from the boiler enters at *i*, filling the valve-chest I. A port *b* being uncovered, steam enters the cylinder B, for example, and expends its force against the annular space at the lower side of the piston D, around the extension D', and moves the piston upward. The valve C of said cylinder being moved downward first covers the port *b*, and later, coincidently with the completion of the upward stroke of the piston D, opens the port *b* to the port *c*² of the valve, and the latter opens the opposite port *c'* to the corresponding port *d* of the cylinder, whereby the ports *b* and *d* are brought into communication through the conduit *c* of the valve, allowing the steam to pass from the under side to the upper side of the piston D, and by difference of areas the excess of pressure at the upper side drives the piston downward. It will be noted that the action of the steam in both strokes of the piston takes place at opposite sides of the same piston and within the same inclosing cylinder, thereby conserving all advantages of temperature. At the conclusion of the downstroke the port *c'* of the valve spans the ports *d* and *e* of the valve-seat and exhausts the steam into the passage *e'*. This action being repeated at opposite times by the opposite valve and cylinder, the proper driving motion is communicated through the pitman E to the cranks F and shaft H.

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

1. In a double-acting compound engine, the combination, substantially as set forth, of two cylinders, each bored out to a larger and smaller diameter in the upper and lower portions, respectively, of its length, a closed

crank-case, into which said cylinders open side by side, constituting the base-support of the engine, a crank-shaft journaled in and through said crank-case below the cylinders and having oppositely-set cranks, trunk-pistons fitting said cylinders, pitmen connecting said pistons with the cranks, respectively, two distribution-valves operating upon seats open to a common steam-supply space, each governing the supply, expansion, and exhaust ports of one of the cylinders, and a single valve moving in connection with the crank-shaft, reciprocating both valves simultaneously in opposite directions, respectively, substantially as set forth.

2. In a double-acting compound engine, the combination of two cylinders bored out to a larger and smaller diameter in the upper and lower portions, respectively, of their length, trunk-pistons fitting said cylinders, a crank-shaft journaled in bearings below the cylinders and provided with oppositely-set cranks, pitmen coupling said pistons and cranks, two valve-seats extended vertically beyond the cylinders, admission-ports leading from each seat into its cylinder adjacent to opposite ends of its larger bore, exhaust-ports leading from the seats beyond the cylinders, and a pair of distribution-valves reciprocating upon the valve-seats in opposite directions, each governing independently the entire distributive functions of one of the cylinders, substantially as set forth.

3. In a double-acting compound engine, the combination of two cylinders, each having a forward prolongation of reduced diameter and a corresponding trunk-piston, a supporting crank-case into which the cylinders open, a crank-shaft journaled in and through the crank-case below the cylinders and provided with oppositely-set cranks, pitmen coupling said pistons and cranks, two valve-seats, each having admission-ports adjacent to opposite ends of the larger bore of its cylinder and exhaust-ports leading outward above the cylinders, and two elongated reciprocating distribution-valves operating upon the seats, respectively, each having ports and an internal connecting-passage carried wholly within the valve for the expansion over of steam to opposite sides of the working-piston, substantially as set forth.

4. In a compound engine, the combination of two cylinders, each bored to a larger and smaller diameter in the upper and lower portions, respectively, of its length, corresponding trunk-pistons fitting said cylinders, a crank-shaft provided with oppositely-set cranks and journaled in bearings below the cylinders, pitmen coupling the pistons to the cranks, respectively, two valve-seats open to a common steam-supply space, a pair of distribution-valves operating upon the seats, respectively, each governing the entire distribution of one cylinder, a single eccentric upon the main shaft, and reversed connections for

operating said valves simultaneously in opposite directions, respectively, substantially as set forth.

5 5. In a vertical double-acting compound engine, the combination of two parallel working cylinders, each having a guide prolongation of reduced diameter, a crank-case upon which said guide-extensions rest, supporting said cylinders, a valve-chest for each cylinder
10 merged into one structure joining the cylinders, a valve for each cylinder effecting the entire distributive function independently as to each cylinder, a reciprocating piston in

each cylinder extended by a hollow plunger in the cylinder-extension, a crank-shaft with 15 oppositely-set cranks journaled in the crank-case, and suitable piston and valve connections with said crank-shaft, substantially as set forth.

In testimony whereof I have hereunto set 20 my hand in the presence of two subscribing witnesses.

JOHN H. EICKERSHOFF.

Witnesses:

L. M. HOSEA,
ELLA HOSEA.